AVIATION NUMBER

# SCIENTIFIC AMERICAN

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Vol. CIII. No. 17
October 22, 1910

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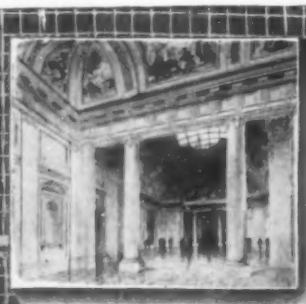

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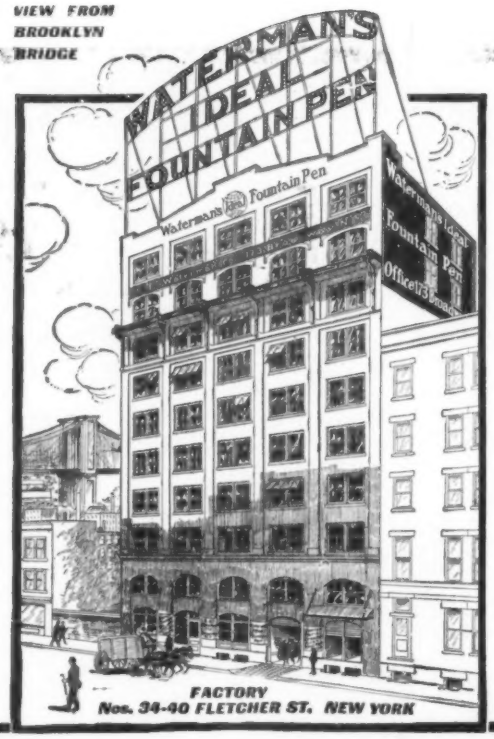


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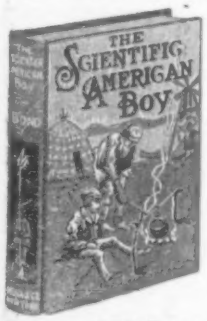


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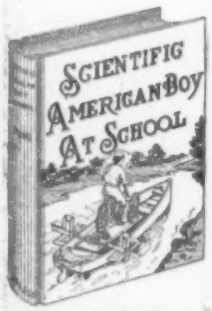


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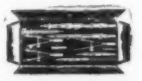

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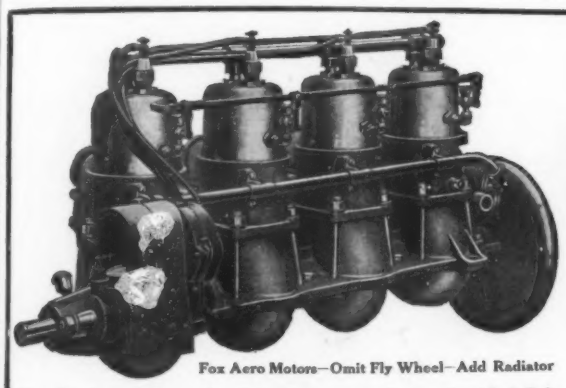

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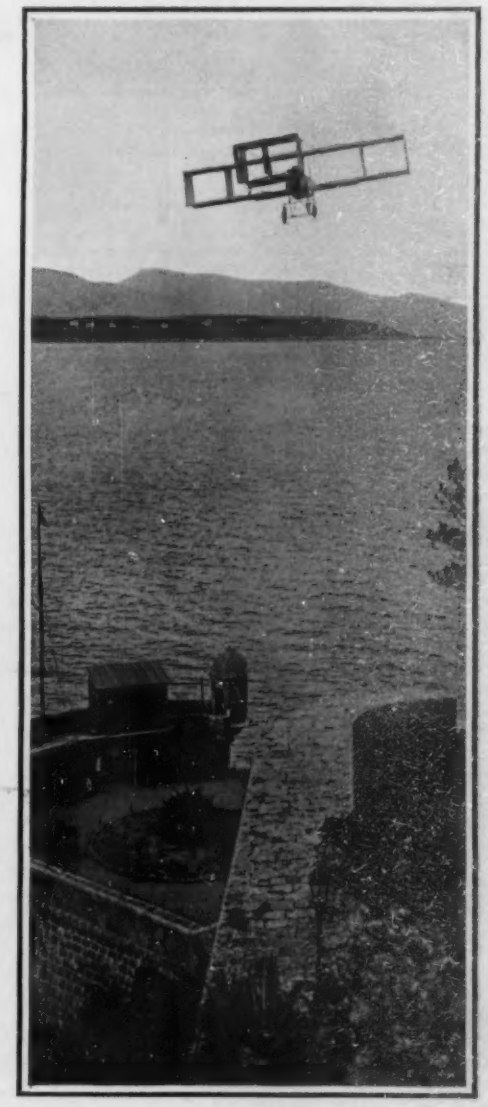
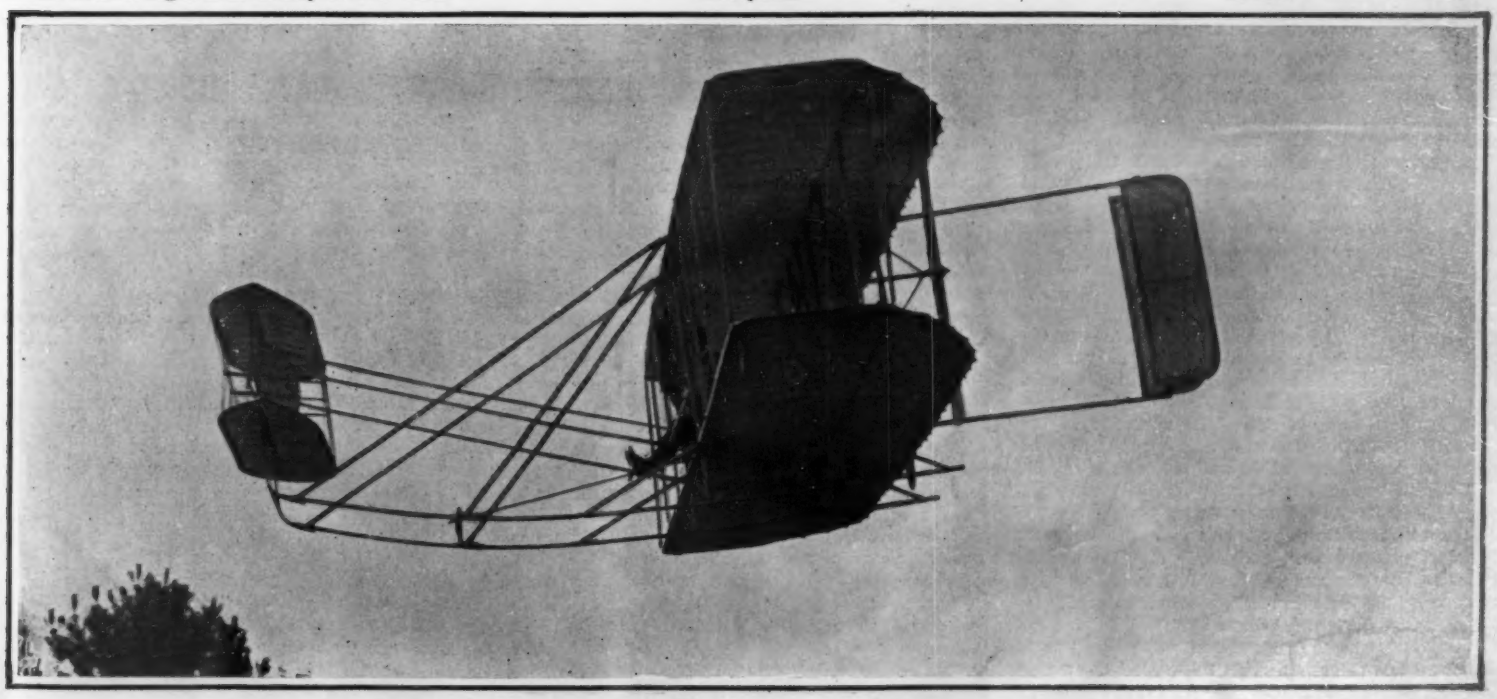
Vol. CIII.—No. 17. ESTABLISHED 1845. NEW YORK, OCTOBER 22, 1910. 10 CENTS A COPY. $3.00 A YEAR.

Curtiss winning the Scientific American trophy on his notable flight from Albany to New York.

Bleriot crossing the English Channel in his monoplane.



Rougier flying a Voisin biplane over the sea at Monaco.



The Wright biplane in its first successful flight for the United States Government at Fort Meyer.

LEADING TYPES OF AEROPLANES IN NOTABLE FLIGHTS.—[See page 315.]

# SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, OCTOBER 22nd, 1910.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.


## MOISANT ON THE ART OF FLYING.

WE had not exchanged half a dozen words with John B. Moisant before it seemed perfectly natural that, on his fourth flight through the air, he should have boldly struck out from Paris to London over a stretch of country which he had never previously traversed, even upon the land. Also this brief impression of his dynamic personality made it seem natural for him to say, as he did a few moments later, "Flying is an easy matter." Of somewhat less than medium height, compactly built, quick of movement, and possessing a happy combination of nerve and good judgment, this latest among the aviators who have distinguished themselves by phenomenal flights, appears to be admirably equipped for what, with due deference to Mr. Moisant's estimate, we shall still continue to call "the difficult and dangerous art of flying."

In view of the fact that Moisant had "never in his life been north of Paris," and was therefore totally unacquainted with the lay of the land and the various topographical features which might serve to guide him to the English Channel, the question naturally arises as to how in the world he found his way. It was done by first marking off the various courses, Paris to Amiens, Amiens to Calais, Calais to Dover, etc., on a map and then following these courses by compass. The first course to Amiens was, if we remember rightly, northeast by north, quarter north. Moisant first rose to a height of about 1,200 feet, and with his eye on the compass (which rested on the floor between his knees) he swung the machine until she was heading on that course. Then, sighting forward, he took a bearing on some large object, twenty to twenty-five miles distant on the horizon, and, disregarding his compass, headed his machine somewhat into the westerly wind which was blowing and flew direct for the mark. This point reached, he again swung his machine on to the true compass course and took a new sight for twenty or thirty miles, repeating the maneuver until, to his great delight, the city of Amiens showed up above the far horizon and dead ahead. Moisant says that by this system he hit every town with an accuracy which satisfied him that, in clear weather, even though a considerable wind may be blowing, it will be possible to traverse with accuracy long distances over unknown lands, provided one has a good compass, and the courses are accurately known.

A curious feature of this trip, dramatic in its way, is the fact that when Moisant told his mechanic to climb aboard, he did not tell him where he was going. That wonderful trip from Paris to London was the first time that this mechanic had ever been in the air. Moisant finds the work of manipulating an aeroplane, when it is once well clear of the aerial waves and billows which lie near the surface of the earth, "a very simple matter." The response of the machine to the various controls is instant and accurate. "Anyone except the timid man can learn to fly; and, having once learned, there is no more, in fact less, danger in flying than in automobile driving." He corroborates the other aviators in the statement that velocity is one of the chief preventives of lateral capsizing. Should a strong air current lift one side, say the right wing, of the machine, equilibrium can be restored by a quick dive and a sharp turning of the machine to the right by means of the vertical rudder. In fact, Moisant declares that he has frequently righted his machine in this way without warping his flexible wings. Baldwin, if we remember rightly, told us that he has tried the same maneuver successfully without using his ailerons.

As to the developments of the future, Moisant is convinced from his experience in the air that the greatest improvement of the future will come in the direction of increased speed, high speed being a better preserver of equilibrium than flexible wing tips, shifting weights, or even the gyroscope. Increased speed will be gained in the two directions of reducing head resistance and increasing engine power. He has been doing some practical work in the former direction in France where, last autumn, he built an aeroplane entirely of metal, with which he claims to have made in two trial flights a higher speed than he could get out of his wood-and-fabric Blériot monoplane of the same horsepower. This machine appears to have been built along the same general lines as those suggested for the racing monoplane, a study of which by the writer is given on another page. On one of the trial flights with this machine Moisant fell from a height of 90 feet. He assures us that his metal machine received only a fraction of the damage which would have resulted from a similar fall in his Blériot monoplane.

## SPECIAL STEELS WHICH MAY LIGHTEN THE AEROPLANE.

IF, as is suggested in another article in this issue, the aeroplane of the future is to be built of metal, it is certain that some form of steel alloy, possessing an unusually high elastic limit, must be used. Otherwise the weight of the construction will be prohibitive.

In recent years, it has been found that remarkable effects are producible in steel by the use of materials other than carbon and iron. Steels whose properties of high elastic limit, great toughness, ductility, etc., are thus due to a third substance are known as alloy steels; and it is the purpose of this article to give a brief description of the principal metals of this kind that may prove more or less available for aeroplane construction.

Perhaps nickel steel is the most valuable of these alloys. Ordinarily, the carbon is kept within the range 0.20 to 0.40 per cent. Nickel may be added in any percentage between 2.75 and 4.50. As a rule, the nickel is not allowed to drop as low as the inferior limit nor to rise as high as the superior one. Nickel steel has a higher elastic limit than carbon steel. This is perhaps its most remarkable property. Now in carbon steels we are able to get a very high elastic limit, but this result is secured at the expense of ductility. With nickel steel, on the contrary, a very high elastic limit may be secured with only a small loss of ductility. Nickel steel is stronger in tension than carbon steel, and its elastic limit is not only absolutely higher, but it bears a higher ratio to its tensile strength. Thus, a carbon steel having a carbon content of 0.30 per cent had an elastic limit of 38,100 pounds per square inch and a tensile strength of 69,400 pounds. The ratio is here 55 per cent. Nickel steels having a nickel content of 3.20 per cent and carbon percentages of 0.25 to 0.30, had elastic limits of 49,300 and 57,300 and tensile limits of 87,400 and 77,800—giving ratios of 56½ and 73½ per cent. Nickel steel develops high resistance to fatigue. It is highly thought of as a bridge material. It is well suited for axles. In this last use, not only is weight reduced, but the area of frictional contact. In addition, its coefficient of friction is lower, so that it becomes highly adapted for axle purposes.

Another important alloy is chrome steel. The presence of chrome in tool steels has been found to promote hardness. The elastic limit is also raised. However, chrome steel when hardened by quenching from a high temperature is quite brittle. The hard surface which this material presents adapts it for quite a number of uses; for example, as a plowshare. But the brittleness constitutes a formidable difficulty. A practical method of dealing with it is as follows: Thin plates of the chrome steel are rolled, and thicker plates of wrought iron. A chrome-steel plate is placed top and bottom of a wrought-iron one, and the three layers bound together by wire. The whole is then heated to the welding temperature and passed through a rolling mill, with the result that a solid three-ply plate is produced. When this has been formed into a plowshare, it is heated to a high temperature and then quenched. The exterior layers become glass-hard and capable of resisting the abrading action of the soil, while the interior layer remains soft and ductile, and thus supplies a kind of cushion and enables the plowshare to withstand shocks and hard usage.

Chrome is often introduced into steel alloyed with still another substance. In this way we may get a combination of hardness and toughness. Comparing such chrome steels with manganese steels, we may observe that the latter are moderately hard and extremely tough. The former may be, when the ingredients are suitably proportioned and the resulting steel properly quenched, excessively hard and fairly tough.

Quite recently the metallic element titanium has come into prominent notice as a valuable alloy substance for steel. It is not known to occur uncombined anywhere in nature, but is quite plentiful in certain iron ores. In the Adirondack Mountains in New York there are great beds of titaniferous iron ores. The specific gravity of titanium is only about 1.25. A remarkable property possessed by it, when heated to a high temperature, is the affinity for nitrogen. Sooner or later this affinity, which is quite rare, may become industrially important. At present, however, the influence of titanium upon steel promises immediate consequences.

Kessler's Curve on the Baltimore and Ohio Railroad in the Cumberland Division is a 9 deg. curve, with the outer rail elevated 6½ inches. Here ordinary Bessemer rails having a carbon content of 0.55 per cent were laid, and also rails of titanium steel with a carbon percentage of 0.48. The rails weighed 90 pounds per yard. The traffic conditions were heavy, so that the comparative test may be regarded as severe. Of the 24 rails laid on October 7th, 1908, 17 were of titanium steel. After nine months' service, the special rails were found to be still in good condition and to have scarcely reached the meridian of their life, while the Bessemer rails had suffered so that it was expected to remove them in a short time. The qualities developed seem to be hardness and toughness. If reference be made to an article in the SCIENTIFIC AMERICAN for January 8th, 1910, "Friction at Railway Curves," the reader will understand the great abrasive effect going on at curves on the head of the outer rail. One may well wonder whether the manganese-steel rail or the titanium-steel rail will better endure the terrific grinding action of flange and fillet on the head of the outer rail. If the rail of titanium steel is even approximately as good, it will probably secure a commercial advantage from the fact that the passage of it through the rolling mill would seem to present no considerable difficulties. As between the titanium and the Bessemer rails, the abrasion of the first four months on Kessler's Curve amounted to 1.45 and 4.18 pounds per yard, respectively. It would seem that the effect of titanium in steel is largely due to its affinity for nitrogen and oxygen.

As to elastic limit and tensile strength, titanium rail steel is better than Bessemer. Thus, tests made upon a titanium steel having the following analysis—C, 0.55; S, 0.043; P, 0.097; Mn, 0.88; Si, 0.143—showed an average ultimate tensile resistance of 120,140 pounds per square inch. The ratio of the elastic limit to the ultimate strength is, accordingly, 72 per cent.

Another metallic element found pure nowhere in nature is vanadium. This, too, has been found to be a remarkable alloy substance. To anyone who has considered it, the effect upon iron of a minute quantity of carbon is astonishing. The ordinary steels used for tools contain only about one per cent of their weight of carbon. And yet this insignificant amount distributes itself everywhere, and produces a metal wonderfully different from iron. Now, vanadium is also a wonderfully powerful agent. If only about one-eighth of one per cent be used, results are obtained. Indeed, it would seem that one-third of one per cent is about the upper limit indicated by present research. Vanadium steel is noted for its high elastic limit and high ultimate tensile strength. But great variations in elastic limit and tensile strength can be obtained by varying the heat treatment. Thus, with forty tests made with steel from precisely the same heat but given various thermal treatments, the elastic limit ranged from 50,500 pounds per square inch to 225,000 pounds, and the tensile strength from 83,500 pounds to 240,975 pounds. The maximum figures, both of which were obtained in the case of a single sample, are enormous. Apparently, we have here a material capable of exhibiting astounding results; and if vanadium steel can be produced in commercial quantities which shows in test elastic limits approaching those produced in the case of this single sample, the aeroplane builder will be in the possession of an ideal metal for his purpose.

The popular interest in aeronautics has not been without its effect upon the inventor. We find patents taken out in this country and abroad for improved methods of generating hydrogen gas for balloons. One of these was recently granted to H. Lane, of Birmingham, England. In his process hydrogen is prepared by passing steam over heated iron, or other easily oxidizable material, and the oxidized product is then lessened by means of a reducing medium, such as water-gas. In practice it has been found that the latter reaction takes considerably longer than the generation of hydrogen; the process is therefore carried out in three or more groups of retorts, the greater part of which are constantly subjected to the action of reducing gases for the regeneration of the iron, or other hydrogen-producing substance. The retorts communicate with one another by means of a series of suitable pipes, fitted with controlling valves, so that steam or the reducing gases may be admitted as required. The hydrogen, which is evolved in the first few minutes of the operation, being impure, is diverted from the collector of pure hydrogen, and mixed with the water-gas used for reduction. A considerable excess of water-gas is used for this purpose, and it undergoes a very thorough system of purification before being admitted to the retorts; the excess, which issues, is freed from the accompanying steam and used again. Means are provided for forcing hot air through the apparatus, which is done periodically between the two reactions, so as to burn out objectionable impurities, especially sulphur.

## AERONAUTICS.

**The German** Ministry of War has decided to award a $25,000 prize for an overland aviation competition, the details of which have not as yet been announced.

There is a movement on foot in Paris to inaugurate a national flying circuit which will govern Paris, Bordeaux, Toulouse, and Lyons. A prize amounting to 250,000 francs may be offered.

**Still another accident,** fortunately one which did not prove fatal, must be recorded. In St. Briuc, the aviator Delafon dropped, and wrecked his machine. He seems to have been flying too close to the ground.

**The firm of Thomann & Co.** has opened a flying machine school at Issy-les-Moulineaux. Gallié is the chief instructor. He is using a new monoplane built by the firm mentioned, which is said to be made entirely of metal.

**Thomas F. Ryan** has offered a $10,000 prize for the fastest flight from Belmont Park around the Statue of Liberty, in the course of the meet, from October 22nd to October 30th. This is the largest prize offered for any single feat.

**The manufacture** of aeroplane motors is, apparently, not quite so profitable as one might suppose. A financial report recently made to the stockholders of the Gnome Company shows that the competition is very keen, and that in spite of the rather high prices charged for aeroplane motors, the amount of profit is not as large as might be supposed.

**The reckless descent** of Parisot in an aeroplane in the very heart of Paris is made the subject of sharp comment in the aeronautic papers. They all recognize how dangerous it is for an aviator to drop suddenly in a public square amid all its traffic. As a result of Parisot's unpremeditated exploit, the Parisian police have taken steps to prevent a recurrence of the incident.

**The English government** still fears aerial invasion. At least we judge this from the more or less constant experiments made at Plymouth in firing upon aeroplanes. The target is not a motor-driven machine, as might be supposed, but a kite towed by a small steamer, the "Adventurer." The kite is kept at an elevation of about 1,800 feet. Up to the present no definite results have been published.

**The balloons** entered in the international race which stars from St. Louis on October 21st are the following: France—"The Ile de France," Mons. Alfred Leblanc; the "Condor," Mons. Jacques Faure. Germany—The "Germania," Capt. von Abercron; the "Harburg," Lieut. Vogt; the "Düsseldorf II.," Herr Hans Gericke. Switzerland—The "Helvetia," Col. Theodor Schaeck; the "Azurea," Capt. Emil Messner. United States—The "America II.," Mr. Alan R. Hawley; the "University City," Mr. H. E. Honeywell; the "Buckeye," Mr. J. H. Wade, Jr.

**Capt. Macievich,** a Russian military aviator, was killed on October 7th, at St. Petersburg, in a fall from a Voisin biplane. The accident occurred during an altitude competition. Macievich had risen to a height of 3,930 feet. He then decided to come down. At a height of 1,640 feet his machine suddenly upset, the aviator was thrown out and reached the ground before the biplane. Every bone in his body, except one arm, was broken. It is the belief of the physician that he died of heart disease before reaching the ground.

**In La France** Automobile et Arienne appears a brief interview with Lieut. Sido, a French army officer, on the subject of the efficiency of the aeroplane during the recent French maneuvers. In commenting upon the possibility of distinguishing at a very great height the position and character of an enemy's forces, Lieut. Sido remarked: "It is simply a matter of keenness of vision and practice. A man who goes up in an aeroplane for the first time cannot distinguish anything below him. Many flights are necessary before he can form a judgment of the terrain below. Good eyesight, coupled with experience, is all that is necessary. It is only rarely that field glasses are required. At a very great height, cavalry is somewhat harder to make out than artillery. By simply counting the number of wheeled trucks, the strength of a battery is easily enough ascertained.

**It is stated** that the Zeppelin north polar airship expedition will start northward from Spitzbergen early next July. The names of the participators will shortly be announced. A successful preliminary examination of the conditions likely to be encountered by the expedition was carried out last summer. A party comprising Prince Henry, Count Zeppelin, and Prof. Hergesell sailed north from Spitzbergen August 3rd on the small ice-ship "Phoenix." On August 4th an ascent was made in a captive balloon over the ice in latitude 80 degrees 19 minutes N., and a series of meteorological observations was made, as well as investigations of several questions relating to aeronautical technique under Arctic conditions. The ice was found to afford bad anchorage; but all other conditions were encouraging. The party returned to Germany August 22nd.

## ELECTRICITY.

**The city council of Chicago** and the Board of Trustees of the Sanitary District of Chicago have ratified the contract whereby the city will be furnished with 10,000 new arc lamps. These, together with the 12,200 now used, will be operated by the power plant of the Sanitary District. The contract calls for installing at least 3,000 of the new lamps within three years.

**The Illuminating Engineering Society** will hold its fourth annual convention this year at Baltimore. The convention proper is scheduled for October 24th and 25th, and it will be followed by a two weeks' lecture course at the Johns Hopkins Physical Laboratory. There will be thirty-six lectures in all, taking up every phase of illuminating engineering.

**A power** transmission cable is to be laid across Narragansett Bay at the mouth of the Providence River, between Conimicut Point and Nayatt Point. The distance across is about a mile and a third. The line will transmit 3,000 kilowatts at 11,000 volts. The cable will consist of three conductors, each with a cross section of 100,000 circular mils.

**A record** for long-distance wireless telegraph communication was recently reported by the Marconi Company. A new station which is being erected at Buenos Ayres, Argentina, has received messages that were exchanged between Glass Bay, Nova Scotia, and Clifden, Ireland. The distance between these two stations and that at Buenos Ayres is about 5,600 miles.

**The British Admiralty** has been making experiments with wireless telegraph communication between ships and submarines. The results of these experiments have been kept secret, but it is rumored that while at first they were unsuccessful, a system has now been developed which is quite reliable. During maneuvers, or in time of battle, such communication would be invaluable.

**Having developed** his storage battery car to a point where it is available for commercial use, Thomas Edison has made another step in the evolution of suburban travel by the invention of a trackless storage battery car. The car is of the pay-as-you-enter type, and is in reality a large motor 'bus driven by electricity. At a recent test of this car, it was run over steep hills and typical suburban roads with perfect success. The cost of operation was found to be about a cent per car mile.

**A recent number** of the Electric Railway Journal records some surprising figures on the weight of paint and varnish used on street cars. On a 12-bench open car, it was found that the paint and varnish amounted to 180 pounds, and on a 14-bench car 221 pounds were used, while in the case of a double-truck, closed car of the pre-payment type, the paint and varnish weighed nearly 600 pounds. This is an item which does not often enter into the calculation of weights when designing a car.

**A novel** pumping system for household service has recently been perfected. It comprises a rotary pump, driven by a small electric motor. The pump operates to force water into an air cylinder, the piston of which operates a switch, stopping the motor when the water has reached a certain degree of pressure. When the water is turned on in the faucets, the pressure momentarily falls, throwing the switch, which starts the pump going and raises the pressure again to the predetermined point. With this system, it is unnecessary to use storage tanks or reservoirs in the house.

**While trackless trolleys** have become quite common in Europe, and are beginning to gain foothold in England, we have not used this mode of transportation in this country, owing to the fact that economic conditions governing the development of suburban lines here are very different from those prevailing abroad. Recently, however, a trackless trolley was started at Los Angeles, California, affording communication between the Los Angeles Pacific Railway and a new settlement a mile and a half away. This system is patterned after the German trackless trolleys. The car carries 16 passengers. It has a range, laterally, of 11 feet, permitting it to pass any vehicles it may meet along the road.

**A well-known method** of separating ores consists in the use of magnetism to pick out the magnetic particles from the non-magnetic. This cannot be applied to ores which have no magnetic properties. However, in recent years, an electrostatic separator has been developed, by which conducting particles may be separated from non-conductors or poor conductors. The finely-pulverized material is passed over a metallic roll, charged to a high tension, and the material is further treated to a stream of ionized air. The particles showing the greatest conductivity are repelled immediately, those showing less conductivity are thrown off a moment later, while the poorest conductors cling to the roll and have to be brushed off. In this way it is possible to separate the particles according to their relative conductivity into several different pockets.

## SCIENCE.

**Prof. Robert C. Ward** of Harvard has recently returned from a visit to Brazil, where he has made a study of the São Paulo coffee district.

**New meteorological stations** established in regions for which few climatic statistics have heretofore been available include one just opened at Santo Domingo, W. I., by Père Bourdon, director of the Episcopal seminary of that city, which will send its reports to the Bureau Central Météorologique at Paris; and one near Guayanaviéja, Venezuela, which has been started by a mining company and will report to the Meteorological Office, London.

**The capt in** of the famous training ship "Worcester," Commander D. Wilson-Barker, R.N.R., has published an interesting brochure entitled "A Sketch of Ocean Meteorology," which is illustrated with several quite unusual photographs. The subjects of these pictures include a solar halo, a sun pillar, a double rainbow, forked lightning, and a complete series of views illustrating the changes of the sky attending the passage of a typical cyclonic storm.

**National** meteorological work in Chile has recently been completely reorganized, and Dr. Walter Knoche, late of Berlin, has been selected to direct the new Instituto Central Meteorológico y Geofísico de Chile, with headquarters in Santiago. This institution has taken over the work in meteorology and weather forecasting heretofore carried on by the Observatory of Santiago, and on January 1st, 1911, will also annex the meteorological service on the Chilean coast, which is now under the administration of the navy.

**Solutions of alum** have long been employed for intercepting the calorific rays of light. The use of alum for this purpose was an article of faith until an experimenter discovered that pure water possesses quite as much absorbent power as a solution of alum. Houston and Logie have been seeking a still more powerful absorbent of thermal rays, which is required in many cases, and have found it in a solution of ammoniacal sulphate of iron. A stratum of this solution, 1.2 inches in thickness, transmits 75 per cent of the luminous rays, but only 5.1 per cent of the total radiation of a carbon filament electric lamp. It should be added that the luminous rays constitute only about 2 per cent of the total radiation, in this case.

**The latest addition** to the world-wide campaign of upper-air research, is the work in this line just begun at Cordoba, Argentina, under the direction of the meteorological service of that country. The work was organized by Mr. H. H. Clayton, late of the Blue Hill Observatory. An aerological staff of five observers is now making, so far as conditions permit, daily observations with kites, and will later undertake balloon observations. The aerological station at Cordoba is notable as the only institution of its kind in South America, and with the possible exception of Samoa, the only place in the southern hemisphere at which regular and frequent soundings of the upper air are in progress.

**In the Bulletin** of the American Geographical Society for September, Prof. Ellsworth Huntington makes a further contribution to the vexed question of climatic oscillations, which he has previously dealt with in his "Pulse of Asia" and other works. Writing of "The Libyan Oasis of Kharga," he finds that the habitability of this oasis, dependent upon its water supply, has fluctuated in long periods coincident with the similar periods or pulsations previously found for regions extending all the way from Egypt through Arabia, Persia, and Turkestan to the far confines of China. Very roughly speaking, the oscillations of rainfall appear to have had a period of about five hundred years; and besides the alternation of dry and wet periods, there seems to have been a slow progressive decrease of rainfall from the earliest historic times to our own. It remains to be seen whether other parts of the world will be found to have had a similar climatic history.

**In the** Chem. Zentr., A. Heydweiller and F. Kopfermann describe a method of glass electrolysis. They have succeeded in introducing heavy metals into glass electrolytically by using fused salts of the metals as anodes. A small tube of soda- or potash-glass, closed below, and containing a fused mixture of sodium and potassium nitrates to act as cathode, was immersed in the fused salt of the heavy metal acting as anode, and current was supplied by means of platinum wires. In this way, sodium, potassium, barium, strontium, tin, lead, copper, iron, cobalt, and silver were introduced into the glass at temperatures above 200 deg. C.; successful results could not be obtained in the case of gold, platinum, and uranium. The metals penetrate the glass in the colloidal state, the color varying according to the conditions. On heating the colloidal solution is coagulated, the more noble metals separating as metal, while the baser metals separate in the form of oxides. Even without the aid of the electric current, metals diffuse into glass from their fused salts, but much more slowly than under the influence of electrolysis.

# Historical—The Development of the Man-carrying, Motor-driven Aeroplane

## FROM THE LILIENTHAL GLIDER OF 1895 TO THE WRIGHT BIPLANE OF 1903

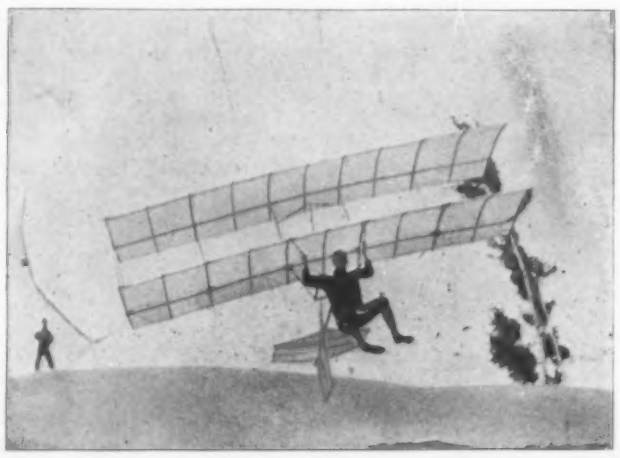
The record of the world's progress in invention contains, surely, nothing that can compare, in the difficulties of the problem and the brilliant success with which they have been met and mastered, with the development of the art of flying. Whatever the twentieth century may have in store—and he would be a bold prophet to set any limit upon its scientific and mechanical possibilities—it is not likely that any accomplishment will surpass that one which to-day is uppermost in the minds of the civilized world.

Outside a very small circle of gifted engineers and scientists, human flight, at the dawn of the twentieth century, was still regarded as a dream of the visionary. To-day, before the first decade of that century has run its course, not only has man learned to fly, but he is flying so far, so high, and so swiftly as to warrant the proud boast, recently made by one of our leading aviators, that the absolute conquest of the air has indeed been accomplished. Flying is a modern art, and it has been achieved—as indeed it could only have been achieved—by the modern method of scientifically conducted experiment, carefully considered invention, and high-class construction by men of large mechanical ability.

Otto Lilienthal in his fatal flight.

Otto Lilienthal.

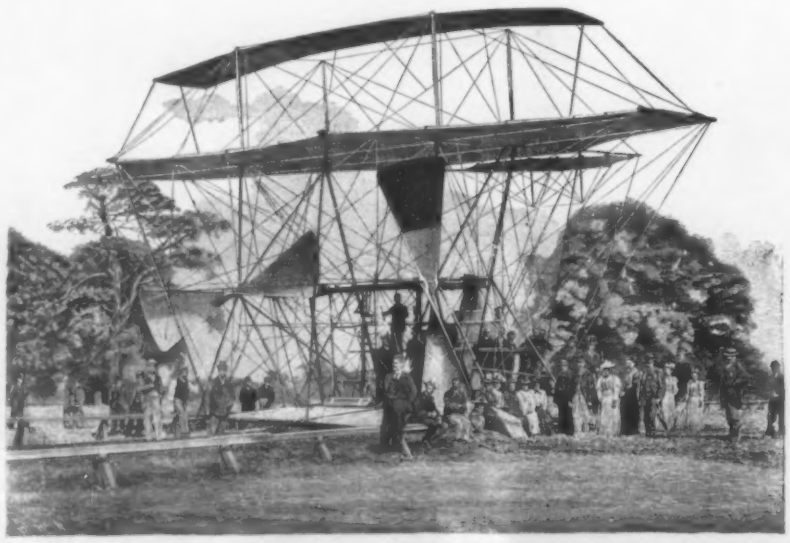
In looking for the actual starting point of the investigation which ultimately rendered human flight possible, we must go back to the year 1888-9, when, by one of those curious coincidences which are frequently observed in the scientific world, several highly qualified men, simultaneously but in different parts of the world, set themselves to the theoretical and practical solution of the problem of flight. These men were Prof. Langley in America, Maxim in England, Lilienthal in Germany, and Hargrave in New South Wales. It was in 1887 that Prof. Langley commenced a theoretical investigation of the laws of aeroplane flight. He built what he called a "whirling table," which consisted of a horizontal rotating arm, at the outer end of which were carried the aeroplanes and propellers which were to be tested. By means of ingenious automatic recording devices, he was able to ascertain the lifting power, etc., of different forms of planes, and the thrust of various types of propellers. The results of these investigations were tabulated in a valuable work entitled "Experiments in Aerodynamics," which was published in 1891. In this work he enunciated the important principle that the area of the necessary supporting surface in an aeroplane varies inversely as the square of the velocity; which means that if a biplane requires 500 square feet of surface for a speed of 40 miles per hour, it would need only 222 square feet for 60 miles an hour; while 80 square feet would suffice for a speed of 100 miles per hour. Langley explained that this was due to the fact that at the higher speeds, the planes passed so rapidly on to new and undisturbed bodies of air that they had not sufficient time to overcome the inertia of the air. He showed that an analogy to this might be found in a skater moving rapidly over thin ice, when his weight was not sufficiently long over any one portion of the ice to break it down. Having now determined the laws of flight, Langley designed an aeroplane of sufficient size and power to carry a man, and he constructed a quarter-sized model to which he gave the name of "aerodrome" or air-runner. This machine, which weighed 27 pounds, and was driven by a one horse-power steam engine, in 1896 made three successful flights, the machine on the 6th of May, 1896, flying for a distance of three-quarters of a mile and alighting safely in the Potomac River. This demonstration was so convincing, that the United States government made an allotment of $50,000 for the construction of a man-carrying machine, which was completed and tried on October 7th, 1903. The machine, a tandem monoplane, was provided with a 50-horse-power steam engine designed and constructed by Manley, which was of unusually light construction. Automatic control was provided, and but for the misfortune of the machine becoming entangled in the launching apparatus, the flight would, in all probability, have been successful. As it was, the aeroplane was thrown into the river, and was so badly wrecked as to render further experiments that year out of the question. Unfortunately for the progress of aviation, a certain section of the press assumed a hostile attitude, and succeeded in discouraging Congress from any further appropriations. The public did not realize that Langley's splendid work was being discouraged just on the very eve of its clearly foreshadowed success. There can be no doubt that this unjust criticism hastened the death of this brilliant investigator, which occurred two or three years later.



Chanute glider struck by a side gust. Body swinging over to restore equilibrium.

Mr. Manley, who acted as the designing and constructing engineer for Langley, recently assured the writer that were the machine to be assembled and reconstructed, it would undoubtedly prove to be a successful flyer. It is to be hoped that some of the wealthy men who are interested in aviation will be induced to make this interesting experiment, and thus establish, beyond all question, the fact that the first successful, man-carrying, motor-driven flying machine was built in the United States fully seven years before the first actual flights with such a machine were made, also in the United States, by the Wright brothers, who in 1903 flew successfully among the sand hills of North Carolina.

It was in 1899 that Hiram Maxim, then resident in England, applied his inventive talent to the problem of flight; and the story of his work, as contained in his recently published work, "Natural and Artificial Flight," forms one of the most interesting records of experiment and invention in the literature of aeronautics. Realizing that one of the principal obstacles to be overcome was that of providing a suitable motor, he designed a pair of compound engines which weighed together 640 pounds, and with a steam pressure of 320 pounds to the square inch, developed 362 horse-power, which is equivalent to 1 horse-power for every 1.76 pounds of weight. Steam was supplied by a water-tube boiler, fired by oil fuel, which weighed 1,000 pounds. Contemporaneously with the construction of the engine, Maxim was investigating the laws of flight. He built a large whirling table, on the outer end of which were mounted the various planes and propellers. With this machine, which was larger and more complete than the Langley whirling table, he secured the necessary data regarding the lifting power of his planes, and the thrust of his propellers. Maxim also constructed a wooden tube, through which a stream of air was driven at high velocity. At the farther end of this he placed the various planes, wooden struts, and other elements of the aeroplane upon which tests were to be made, and by means of delicate automatic registering appliances, he gathered in and tabulated a vast amount of practical information, which, even to-day is used as a basis of reference by designers of aeroplanes. Perhaps the most remarkable thing about Maxim's work was the ambitious scale upon which he built his aeroplane, which consisted of a main aeroplane with two rudders, one forward and one aft, and had two inclined lateral planes carried one on each side of the machine. The total width of the machine was 104 feet, the lifting surface comprised 4,000 square feet, the weight was nearly 8,000 pounds, the thrust of the two huge propellers, each 18 feet in diameter, was 2,100 pounds. The speed, when the engines were developing 360 horse-power, was 38 miles an hour. With 600 pounds of water in the tank and boiler, and three men aboard, the total weight was about four tons!



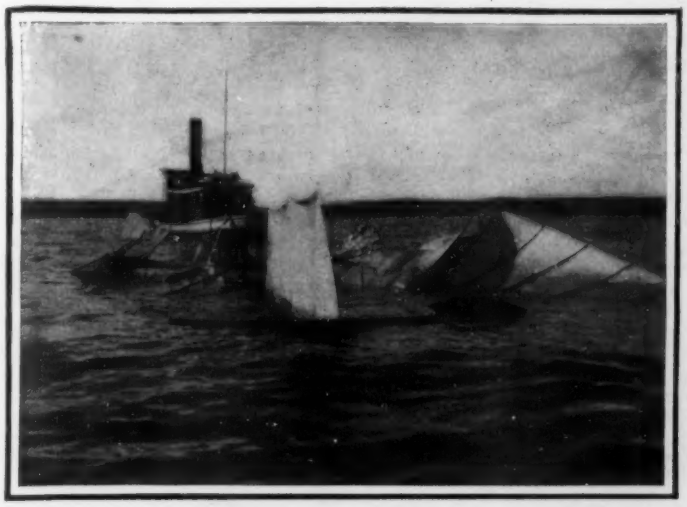
Lifting surface, 4,000 square feet. Propeller thrust, 2,100 pounds. Speed, 38 miles.

The huge, 4-ton Maxim aeroplane of 1892.

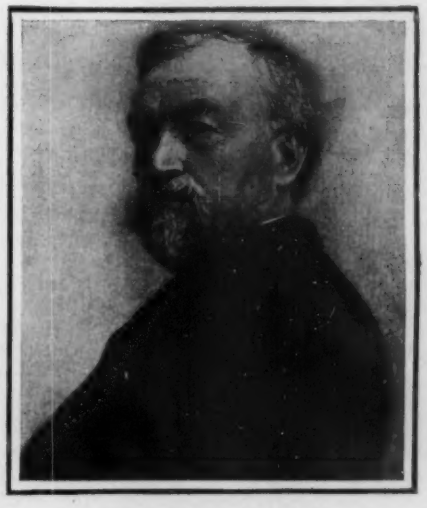
In trying out the machine, two holding-down rails were provided, against the under side of which four guide wheels on the machine were supposed to bear, the idea being to get the machine off the ground and allow it to run a few feet above the surface. On the trial, the machine not only rose from the ground, but lifted so heavily against the holding-down rail that one of the two-inch axles was bent, the rails were torn up, and the costly machine was wrecked. Discouraged by this failure, this costly work, upon which it was estimated that nearly $100,000 had been expended,

was abandoned. Now in the case both of the Langley and Maxim aeroplanes, it may be said that their failure to fly was due largely to man's inexperience in the art of flying. Had a Wright, a Curtiss, or a Blériot been available, with his knowledge of the feel of the air, it is possible that both of these machines might have made successful flights; certainly the Langley machine would have done so.

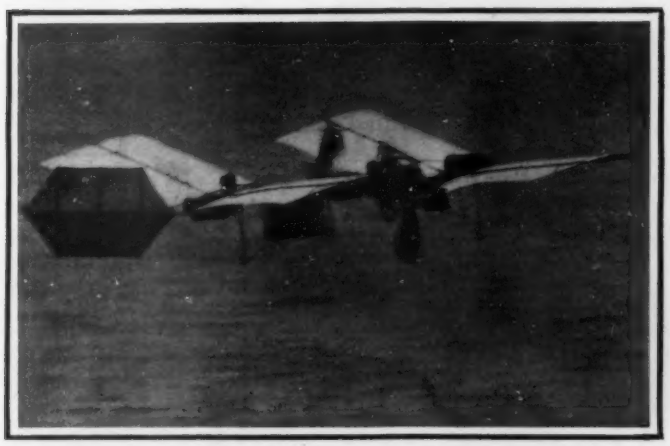
Fortunately for the progress of the art, two very able investigators, Otto Lilienthal in Germany, and Octave Chanute in the United States, were wrestling with the problem along these very lines, and by means of comparatively simple, cheap, and easily constructed "gliders," in which gravity takes the place of the motor as a propelling force, they were actually making



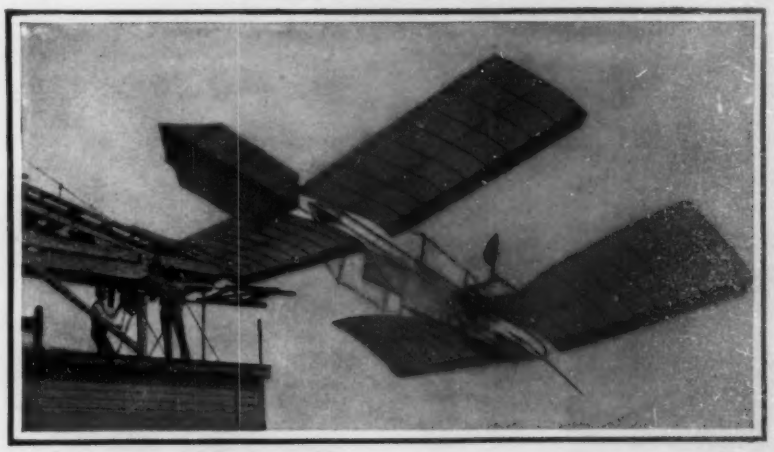
Towing the wrecked Langley "aerodrome" back to the houseboat, 1903.



Samuel Pierpont Langley.



Langley's last model. Telephoto snapshot of it in flight. ¼ size model.



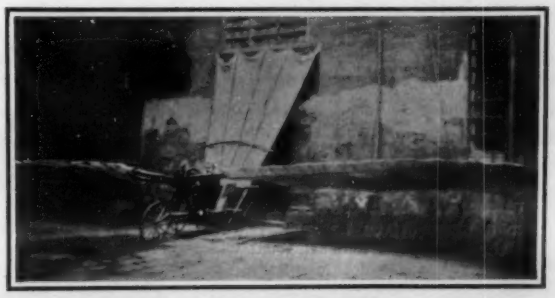
False start of Langley "aerodrome," 1903.

flights through the air, and either proving or correcting the laws of flight, which Langley and Maxim had demonstrated with their whirling table and other apparatus. Lilienthal, who was a German engineer, built a large number of aeroplanes, with wings broadly resembling those of a bat, and during the period 1891 to 1896, using an artificial hill constructed especially for the purpose, he made over 2,000 gliding flights through the air from summit to base.

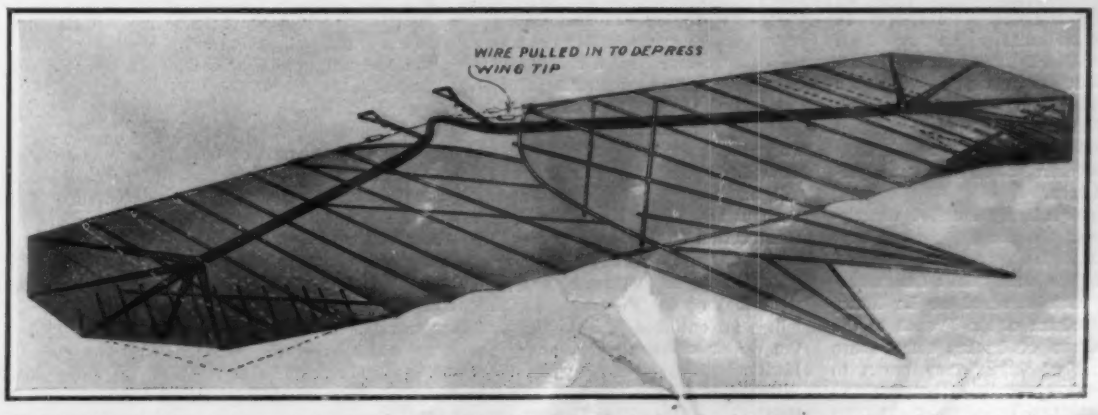
Now these experiments of Lilienthal, and also those of Chanute, which came a little later, were mainly directed to the discovery of the best means for preserving equilibrium. Speaking on this question of equilibrium, Mr. Kimball recently likened an airman when afloat in his machine to a man who is seated at the apex of a practically frictionless dome, who, unless he can prevent it, must inevitably slide down over the dome, either forward or backward or to either side. A glider will move in equilibrium as long as the center of gravity of the machine and the operator is in the same vertical line with the upward thrust at the center of air pressure. If the downward pull at the center of gravity is forward of the upward thrust at the center of air pressure, the machine will pitch forward. The conditions being reversed, the machine will pitch backward. Should the center of gravity be to the right of the center of air pressure, the machine will turn over to the right; conversely, if the center of gravity be to the left of the center of pressure, the machine will turn over to the left. Lilienthal corrected any eccentricity of the centers of gravity and air pressure by shifting his weight. Unfortunately for the aeronautical world, he was killed in 1896 by the falling of his machine.

Lilienthal's work was taken up by Pilcher in England, who early became a martyr to his zeal, and in America by the well-known civil engineer, Octave Chanute, who in 1896 began his classic experiments in gliding. He and Herring introduced the most valuable principle of controlling the balance, not by shifting the weight of the operator, but by altering the pitch of the planes themselves, or of their accessory tails, in such a way as to bring about the needed shift in the center of pressure. Chanute constructed gliders with multiple planes, carried one above the other; and he was first to introduce the Pratt system of trussing, with vertical wooden struts and diagonal wire ties, the first biplane of this type being built by him in the form of a glider. During these experiments in 1896 and 1897, Chanute, with Herring as an associate, made about two thousand gliding flights; and in 1897, in an article published in the Aeronautical Annual, Boston, giving an account of what had been done, he invited other experimenters to improve upon his practice.

This invitation was accepted by Wilbur Wright, who, after applying to Chanute for the necessary information as to principles of flight, materials of construction, etc., built a biplane glider and settled down, with the assistance of his brother, to the work of carrying on the labors of Lilienthal, Chanute, Langley, and Maxim to a successful completion. The two brothers built a glider, and between 1900 and 1903 they verified the work of earlier experimenters, and added a vast amount of valuable data of their own. They introduced the forward horizontal rudder. When they had satisfied themselves that their control of the machine was sufficiently complete, they added a motor to their glider, and on the 17th of December, 1903, with a 16-horsepower motor driving two screw propellers positioned at the rear, they made a short flight of a few seconds' duration. Subsequently, during the same experiments, a flight of 850 feet was accomplished.



Mouillard glider of 1895 with movable wing-tips.




The Mouillard glider had movable wing-tips, operated by wires by the broad method now used on modern aeroplanes.

Here then, down among the sand dunes of North Carolina, two typical American mechanics, intelligent, persevering, ingenious, and infinitely painstaking, reached that goal of human flight which had been a coveted prize for centuries past. The brothers went back to their home, Dayton, Ohio, where, after spending a year in learning how to make a successful turn, on October 5th, 1905, they accomplished a flight of 34 miles in 28 minutes at a speed of 38 miles per hour.

In producing a successful flyer, the most important problem solved by the Wright brothers was that of maintaining lateral stability. If an aeroplane is inclined laterally beyond a certain degree, when flying at a given

speed, it will slide laterally to the ground. This tilting may be caused by a puff or air current striking one side of the machine, or by the tendency of the outer wing to rise when the machine is rounding a curve. Chanute and Herring imparted fore and aft stability to their glider by means of a tail and by making the planes adjustable. Wright realized that before a practical machine could be evolved, it was necessary to provide not only fore and aft, but lateral stability; and that the machine should also be able to make a turn under perfect control of the operator. They solved the problem by means of a manually controlled device acting on the rear portions of the planes, by which the angles of incidence could be changed, the air pressure being thus increased on one side and decreased on the other. They also discovered that in "warping" the planes, it would be necessary to bring the rear vertical rudder into play in order to maintain the machine in perfect control. They therefore provided means for making the flexible wing tips and the vertical rudder operate together and simultaneously. They covered this arrangement by a broad patent, the litigation upon which promises to rival that of the Bell telephone patents.

The principle of warping the wing tips was not new with the Wright brothers. As far back as 1895, L. P. Mouillard constructed in a Moorish convent at Cairo, Egypt, a large monoplane glider, the materials of which consisted of bamboo and canvas. The feature which renders this machine of great interest at the present time was the provision of flexible rear portions at the outer ends of the wings, which could be operated by means of wires and pulleys when the machine was in flight. These wing tips were used by Mouillard in place of a vertical rudder for steering to right or left, which was accomplished by pulling down the tip on the side to which the machine was to be turned. Mouillard's glider formed the subject of a patent, now being widely quoted in Europe in defense of the infringement suits which have been brought by the Wright brothers. As a matter of fact, Wright never claimed that the manipulation of the wing tips was original with him; but he does claim that the co-operation of the wing tips and the vertical rudder is not only original with him, but is absolutely necessary to the effective control of an aeroplane, particularly when making a turn.

Limitations of space prevent any detailed description of the development of the aeroplane since that eventful day, December 17th, 1903, when the first successful flight was made. The first public demonstration by the Wrights, which occurred at Le Mans, France, aroused the enthusiasm of the French to the highest pitch; and, desirous of having some share in the early development of flying, they began to experiment and build with characteristic ardor and intelligence. It is sufficient to mention the names of Santos-Dumont, Ferber, Farman, Voisin, and Blériot, to bring to mind the wonderful success of the French in their own country. The monoplane appealed to the Frenchmen as presenting the best and most natural form of flyer, at least for high speed, and the records of over 70 miles an hour in speed, 244 miles in distance, and 8,700 feet in altitude, which have been made by the Blériot monoplane, would seem to indicate that they were right. Here in America the biplane, represented principally, we might almost say exclusively, by the Wright and Curtiss types, has continued to be the favorite. Both Wright and Curtiss have built special racing machines for the international meet at Mineola, and as several of the fastest French monoplanes, and the ablest French aviators, have come over to compete for the international trophy, the question of superiority of type will be in a fair way to be definitely established.

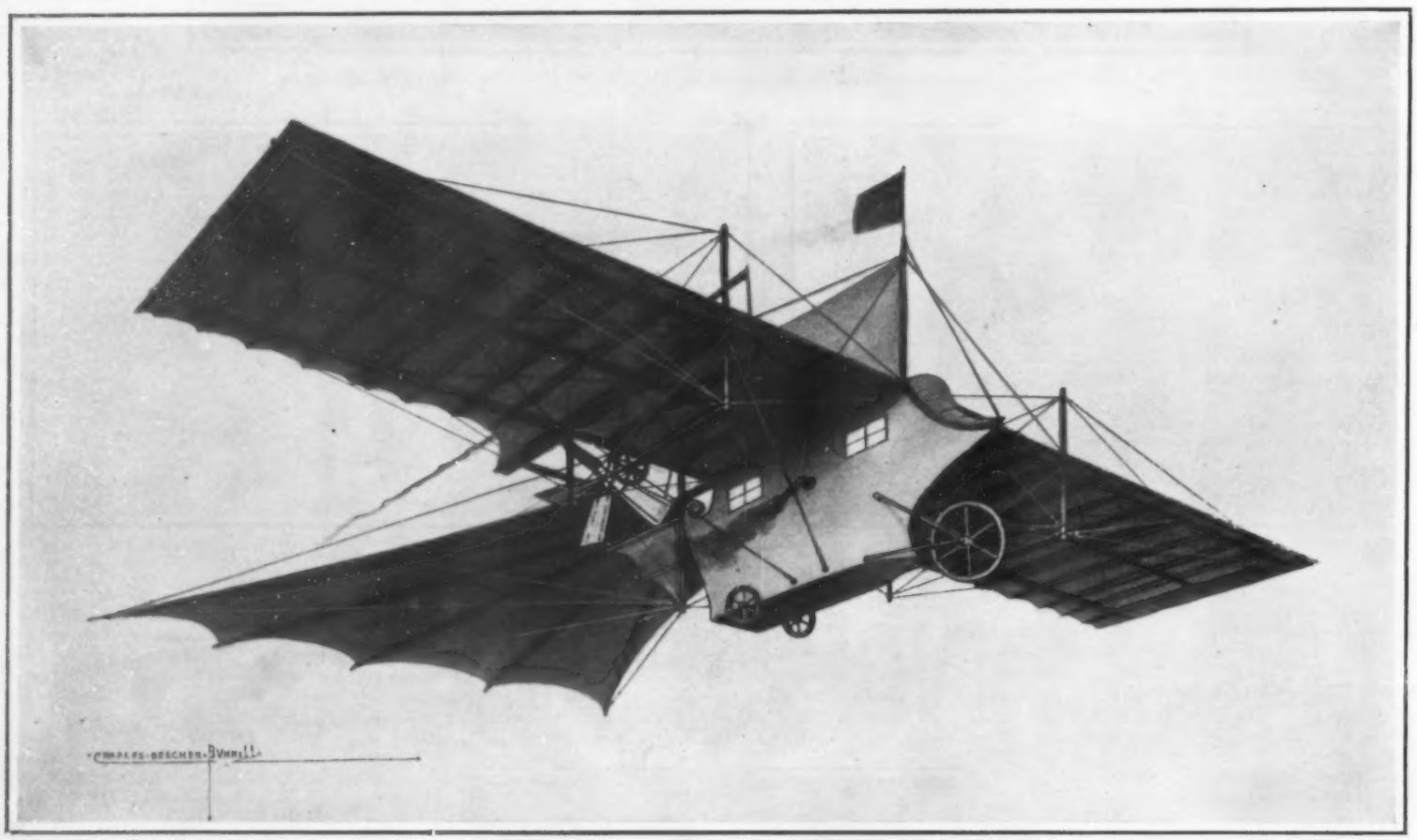
## HENSON'S AEROPLANE OR "STEAM CARRIAGE" OF 1843.

In the preceding article we have traced the development of the practical aeroplane through that remarkable period of scientific and practical investigation which gave to the world the flying machine of to-day. In that article we dealt only with machines which were actually built and given a practical trial. Although the period dealt with covers only twenty years or so, the problem of mechanical flight had proved an attractive theme to the inventive mind long before the era of Lilienthal, Chanute, and Wright. Striking evidence of this is afforded by the design of Henson for a steam-driven aeroplane, which was published in the year 1843, and attracted widespread attention. Considering that nothing, as far as the records go, had been previously attempted along these lines, Henson's aeroplane must be set down as one of the most astonishing anticipations of modern invention that the world has ever seen. It needs but a glance at the accompanying drawings, in which our artist has followed with great fidelity the original line drawings, to see that over half a century ago Henson had not merely grasped the general principles, but had also anticipated the actual construction of the aeroplanes that are performing such wonders in the air to-day. There is the main, central, longitudinal body of the monoplane, with its pair of wings, a hinged rear tail, and a rudder for horizontal and vertical control. Perhaps the most remarkable thing of all is that the construction of the wings, with their ribbing and silk covering, stayed above and below by wires to central posts placed in the main body, is almost identical with that of the French monoplane; and the parallelism is continued even to the auxiliary trussing at the center of the planes, an arrangement which is identical with that of the present Antoinette machine. Whether his steam carriage would have flown or not, it is evident that either Henson himself, or the expert assistant he may have employed, was a trained engineer, who had made a thorough study of the stresses to which an aeroplane would be subjected, and who well understood the best way to take care of them.

As was to be expected, Henson's "steam carriage" met with the usual criticism and cheap ridicule, and we subjoin an extract from an article by Prof. Partington, which was published in the year 1843 in the Illustrated News of London:

"The peculiar feature of Mr. Henson's invention consists in the use of light frames, which may be covered with silk or linen, and placed in such a position that they form with the body of the aerial vehicle an angle similar to that of a bird when in the act of 'skimming' through the air. The first impulse is intended to be given to the carriage by means of an inclined plane, down which it is to slide. With an apparatus thus constructed, there is no question but what a velocity might be attained capable of supporting the framework with the necessary covering for a short period of time; but a few, a very few seconds, must insure its descent to the earth; despite the operation of the steam propellers. Mr. Henson has properly gone to nature for the position of the bird's wing, but he has lost sight of the important fact that in animal mechanics the prime mover possesses an organization altogether different from that of elastic vapor giving motion to brass and iron. In the same way, it was proposed by another inventor to move propelling wings by human power, when one of our most eminent anatomists has demonstrated that the muscular power of a man is not one-eighth of that of a bird. A pigeon has been known to fly a hundred and ninety miles in five hours and a half—a speed that no human being can ever attain; while the velocity that must be imparted to the propellers for the mere support of such a machine, under the most favorable circumstances, must be vastly greater than was ever yet imparted to any machine constructed by the ingenuity of man. There is another fact, of which we ought not to lose sight in estimating the practical utility of the aerial carriage. Its framework, or wings, on which everything must necessarily depend, are 150 feet long, by 30 feet wide, offering an area of 4,500 feet; and, when we look at the mechanical resistance offered by the air to a surface of that extent, it is hardly possible to conceive a plane so knit together by human workmanship as to preserve its stability. The fate of Mr. Cocking is still fresh in our recollection. Garnerin had, descended with perfect safety, and so had Mr. Hampton, by the tension of a woven fabric, but, as soon as a framed parachute was opposed to the resistance of the air with an increased velocity, which would be the case in the present instance, the entire machine was broken into shreds. The condensing steam engine, by which the

(*Continued on page 330.*)



An extraordinary anticipation of the modern aeroplane. Planes 150 feet by 30 feet. Supporting area 4,500 square feet.

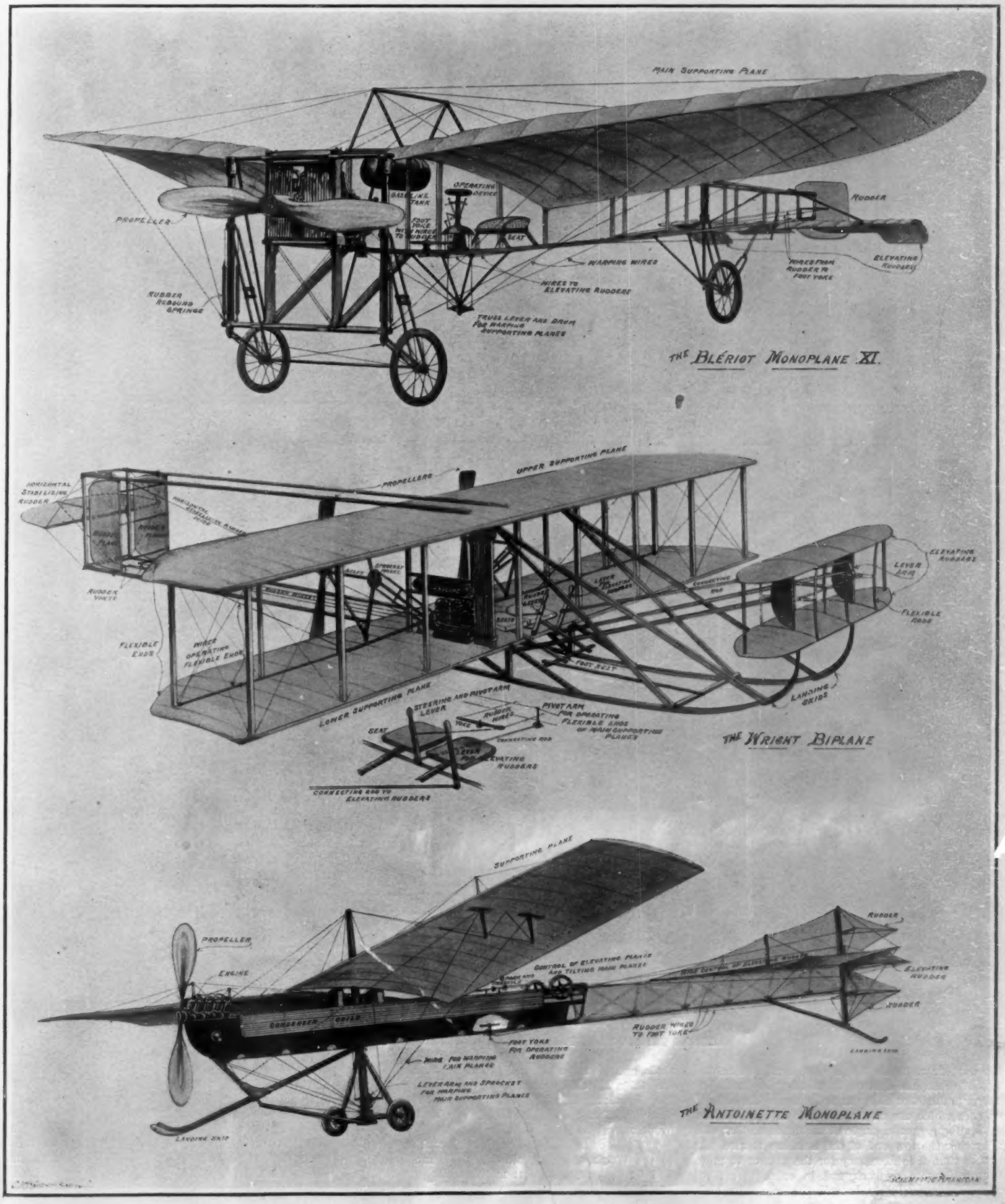
THE PROPOSED HENSON STEAM-DRIVEN AEROPLANE OF 1843.

# LEADING FRENCH AND AMERICAN AEROPLANES

## THEIR CONSTRUCTION AND METHODS OF CONTROL

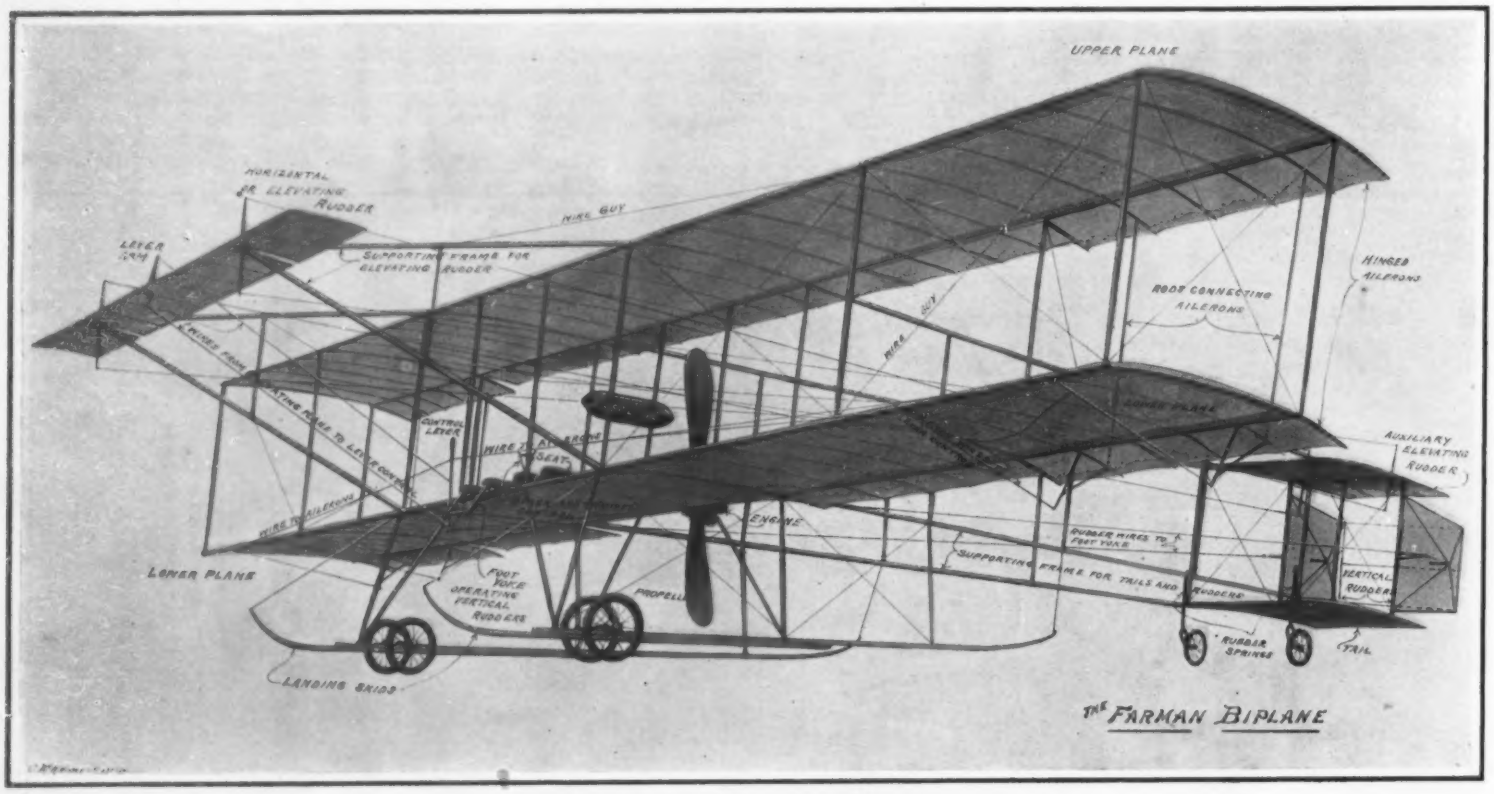
With a view to making clear the construction and operation of the leading types of aeroplanes, we have prepared the accompanying drawings, which show the various means by which the machines are controlled when in flight. The drawings are so complete as to call for only a brief description.

In the Wright machine, the four-cylinder, water-cooled motor of 30 horse-power is placed slightly to the right of the center line of the machine. The seats for the aviator and passenger are slightly to the left of the center line, at the front edge of the lower plane. On either side of the outermost seat, which is the aviator's, there are two levers. The aviator holds these in his right and left hands respectively. The one at his left is connected by a wooden rod to a bell crank mounted on a horizontal tube, which runs from one end to the other of the double-surface elevator, or horizontal rudder, in front of the machine. Several horizontal arms, mounted on this tube, connect with flexible uprights at the front and rear edges of the surfaces of the horizontal rudder, and when the tube is rocked by the bell crank in response to a fore-and-aft movement of the operating lever, these cross rods and flexible uprights tip the surfaces of the rudder upward or downward and at the same time curve them on their under sides when the rudder is turned upward, and on their upper sides when it is turned downward. This automatic curving of the surfaces of the horizontal rudder forms the subject of a special patent. The latest Wright biplane has a movable tail surface attached to the end of the outriggers that support the vertical rudders. This surface is shown in our illustration. It works in conjunction with the front horizontal rudder. When the former is turned upward to ascend, the rear half of this tail surface is also flexed upward. The result is that the tail of the machine is depressed, while the front end is raised. The machine, therefore, responds more readily to its horizontal rudders. (On the very latest of their

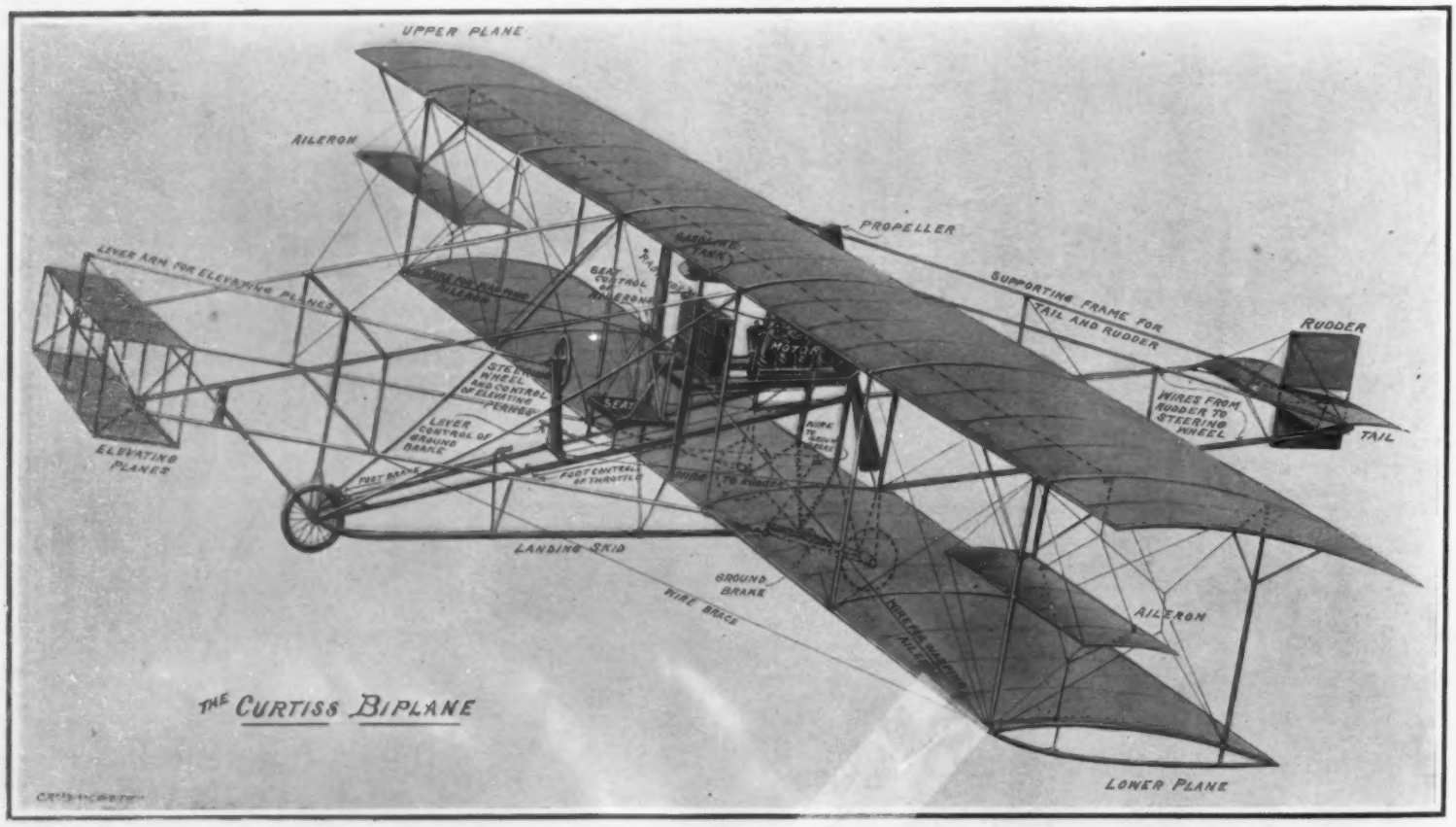



**Leading types of aeroplanes and their methods of operation.**

biplanes, the Wrights have dispensed with the front horizontal rudder entirely.) The right-hand lever is a double-jointed affair, the handle of which is pivoted so that it can be worked sideways upon the lever proper. A connection extends down from the handle to a small disk or drum, so that when the handle is rocked to one side or the other, the drum is rotated slightly. The chain passing over this drum connects with the warping wires which warp the outer rear ends of the plane. A forward or backward movement of the lever works the vertical rudders at the rear plained elsewhere in this issue. The simultaneous warping of the wings and turning of the vertical rudder is the chief claim of the Wright patent. The propellers used on this machine are of the slow-speed variety, having pitch equal to diameter (about nine feet). They are driven by sprockets and chains from the engine, one of the chains being crossed to reverse the motion of the propeller. The chains pass through tubular guides. The radiator consists of a set of flattened tubes, extending between the two surfaces just in front of the engine. The machine is mounted on propeller has two blades and is mounted directly on the rear end of the engine crank-shaft. The engine sits upon a heavy frame of wood, with a radiator in front, just back of the aviator's seat. The control wheel is mounted on a swinging post in front of the aviator, and there is a pivoted frame of steel tubing which fits around the aviator's shoulders, and which is connected by wires to the ailerons, or balancing planes, located at the ends of the machine between the two main planes. When the machine tips to one side, the aviator naturally moves his body to the high




The Farman 50 horse-power biplane.




The Curtiss biplane with intermediate adjusting planes.

LEADING TYPES OF AEROPLANES AND THEIR METHODS OF OPERATION.

in the way shown in the diagram. When the machine tips to one side, the aviator, by moving the handle of this lever to the other side, warps downward the ends of the planes which are on the low side of the machine, thus forming a greater angle of incidence on that side and causing the low end of the machine to rise. At the same time it is necessary for the aviator to move the lever forward or backward in order to set the vertical rudders slightly toward the other, or high, side of the machine, and thus counteract the tendency of the aeroplane to turn about a vertical axis, as ex-

skids, and the more recent type has wheels attached to the skids by elastic bands, so that it can start by running along the ground instead of having to be launched from a special starting rail by means of a dropping weight.

The Curtiss biplane is similar in general appearance to the Wright machine, although it is much smaller and lighter. In the latest machine, the upper plane is somewhat longer than the lower one, as shown in our illustration. An 8-cylinder, V-motor of 50 horse-power is used on the larger Curtiss biplane. The

side of the aeroplane, and in so doing, carries with him this swinging frame and causes it to set the ailerons (pulling one downward and the other upward) in a proper manner to right the machine. Steering up and down is accomplished by pulling or pushing on the control wheel, while turning this wheel operates, through wires, the vertical rudder at the rear. The tail surface is fixed. The machine is mounted upon three wheels without the use of any springs.

In the Farman biplane, the aviator sits upon a seat

at the front edge of the lower plane, in the center. The revolving-cylinder motor placed at the rear edge of his plane, also in the center, carries the propeller directly upon it. The machine is operated by a single control lever to the right of the aviator, and also by a foot yoke which operates the vertical rudders at the rear. Pushing or pulling on the control lever moves the front horizontal rudder, while swinging this lever sideways pulls down on the ailerons or hinged flaps at the outer rear edges of the two surfaces. When the machine is stationary, these flaps hang downward, and when it is in flight the air pressure holds them out horizontally. Should the machine tip, the ailerons on the low side are pulled down, thus causing it to right itself. The machine is mounted upon two skids, each of which is fitted with a pair of wheels. Heavy elastic bands connect the skids to the axles of the two wheels. In alighting, the bands give and allow the skids to take the main shock. This machine also has an auxiliary elevating rudder at the rear of the tail, so connected that it works in conjunction with the front horizontal rudder. It was the first biplane to use this auxiliary rudder.

The Blériot monoplane consists of a long central body, carrying two wings in front and a tail and rudder at the rear end. Wheels are mounted in forks at the front and arranged so that they can pivot about the two uprights of steel tubing which form the side members of the front frame. There are also elastic shock absorbers which allow these wheels to play up and down in running over rough ground, or when alighting. A three-cylinder, air-cooled motor, or a 7-cylinder, revolving motor is generally used on this machine; but in our illustration a double-opposed cylinder, water-cooled motor carrying a propeller on its crank shaft is shown mounted back of the radiator, which fills the front of the frame. The aviator's seat is placed about on a line with the rear edge of the wings, and the control of the machine is centered in a universally-mounted steering column with a small wheel on top. This wheel does not turn. Below it are levers for the spark and throttle, while the foot yoke or tiller is placed in front of the control column. This operates the rudder at the rear. The horizontal rudder consists of movable tips on the ends of the tail surface. These operate together and steer the machine up or down when the control wheel is pulled toward or pushed away from the aviator. To correct any tipping, the rear part of the wings is warped by means of a cable running from one wing to a small wheel on the tripod below the frame, wrapping around and passing this wheel, and extending to the wing on the other side. When the control post is moved to one side or the other, the wings are warped by suitable connections. The chief point in this Blériot control is an aluminium bell seen near the base of the control column. The universal joint is within this bell. The object of the bell is to make possible a movement in any direction of the control column without undue tightening or loosening of the control wires.

The Antoinette monoplane is much larger than the Blériot, and consists of a V-shaped body, upon which are mounted a pair of large wings, suitably trussed and supported from a heavy central mast of steel tubing. This mast contains a pneumatic shock absorber in its lower end, besides which there are two wheels with very heavy pneumatic tires. A long inclined brace projects down in front to protect the propeller when landing. An 8-cylinder V-type motor of 50 horse-power is placed in front, and drives a 7-foot propeller. The aviator's seat is back of the wings in the body. The vertical rudder, which is in two parts with the horizontal rudder between the two, is operated by a foot yoke or tiller. The horizontal rudder and the warping of the wings are both controlled by two wheels placed one on each side of the aviator. A skid in the rear is used in place of a wheel to support the tail. There is a horizontal fin on each side of the body at the rear, and a vertical fin above it. The front part of the body is substantially made of wood, and covered with veneer. The machine is very large and heavy, but it has shown great automatic stability, chiefly on account of the shape of the body.

# THE RACING AEROPLANE OF THE FUTURE—A STUDY

BY J. BERNARD WALKER

A study of the trend of development in aeroplane construction renders it possible to predict with some degree of certainty the leading characteristics of the aeroplane of the future, and especially of that type which will be built purely for racing purposes. The following is an attempted study along these lines. The writer has no wish to assume the role of prophet, and the accompanying drawings and description are based mainly upon a survey of the work which has been done during the present year of phenomenal development by the designer, the constructor, and the airman. The keynote of this development is to be found in the fact that the speed of the aeroplane in straight-away flight has risen during the past year from fifty to seventy-five miles an hour, and that the "blue ribbon" of the air (if we may borrow a nautical phrase) has passed from the biplane to the monoplane, the type which, at the present writing, is so far in the lead, as to speed, lightness, and stability, that it stands in a class by itself.

The racer of the future, then, will be a monoplane; and in narrowing down to this type, man is but treading in the footsteps of Nature, the master builder, who, working through a process of evolution that has stretched out over millions of years, has produced, in that wonderful bird, the albatross, the perfect flying machine. The future high-speed flyer, then, will possess the same tapering, rounded body and the wide-spread wings of narrow width which characterize the swiftest of the birds. Langley, in his classic researches, showed that it was the leading portion of a plane which was the most efficient, and this for the reason that it was continually moving on to fresh bodies of undisturbed air. He showed that as the after portion of the plane had to do its work upon air which had already received from the forward portion a downward velocity, this air was unable to provide the effective reaction which was exerted by air absolutely inert. Hence it follows that a plane 5 feet in width by 10 feet in length would be rendered more efficient if it were divided longitudinally, and the same area were presented in a plane 2½ feet wide and 20 feet in length. The wings of the racer will be long and narrow; and when they come to be built of metal instead of the present wood and fabric, it will be possible to give them those sweeping, rounded forms which prevent eddy-making, and also, from a constructional point of view, add not a little to the strength. The body will be of a generally circular or oval section; and to allow of a long and gradual taper, for ease in traversing the air, the body will have considerable length. The greater length also will add greatly to the fore-and-aft stability in flight.

The present wood-canvas-and-wire construction will have to go. It is makeshift work at the best, and was adopted because, in the early days of experiment, it offered a cheap and light combination of material, and one which, in the event of the inevitable breakages, incidental to experimental work, could be cheaply and quickly repaired. Its place will be taken by some one of the many remarkable alloys of steel which are now available—metals of enormous strength and toughness in proportion to their weight. The use of these, coupled with careful designing by the skilled engineer, will make it possible to produce an aeroplane of much greater strength, that will weigh no more than the present machine, and will present far less resistance.

The principal resistances encountered by an aeroplane when in flight are those due to the lift and the head surface. The resistance due to the lift is fairly constant; for as the speed increases the angle of incidence decreases, and there is always an adjustment between the two which provides sufficient vertical reaction at all times to lift the weight of 500 to 1,000 pounds, as the case may be. The head resistance, however, increases approximately as the square of the speed; and if it is 100 pounds, say, at 40 miles per hour, it will rise to 400 pounds at 80 miles per hour. Hence the great importance, in a racing machine, of reducing the head surface to the least possible limit consistent with structural requirements.

It is this consideration of head resistance which has doomed the biplane as a purely racing type. When Octave Chanute built the first biplane glider, with its light, but very rigid Pratt trussing of vertical wooden struts and diagonal wire ties, he produced an excellent piece of engineering construction, which has proved to be ideally adapted to the early experimental stage which is now drawing to its close; but for high-speed results, because of the large amount of head surface presented, the Pratt truss was doomed to ultimate extinction. Unquestionably, the higher speeds which have been attained by the monoplane are due largely to the fact that its trussing is simpler, and the head surface, particularly of the wire stays, is relatively much less.

Now a word as to the resistance offered by a mass of tightly-strung wires. Prof. Langley showed in his whirling-table experiments that the resistance of a wire is much greater than that which would be due to its projected area. As the speed increased, the resistance would rise rather quickly until, at a certain critical point, at which the wire would sing with a peculiar note, there was a sudden and very large jump in the resistance. This is explained by the fact that the rate of vibration of the wire under the rush of air is so great that it practically presents a solid surface, whose width is equal to the amplitude of vibration. Hence a tightly-strung wire presents a resistance to the air which is seemingly out of all proportion to its actual surface.

It follows, then, that even the simple king-pin trussing of the Blériot and Antoinette types must go if we are to achieve the high speeds which are predicted for the future racing machine. Now this will be possible only if some high-grade sheet metal is substituted for the canvas of the wing surface, and the necessary transverse bending strength is secured by means of plate-steel members inclosed within the wing surfaces and strongly riveted to the structure of the main body of the machine.

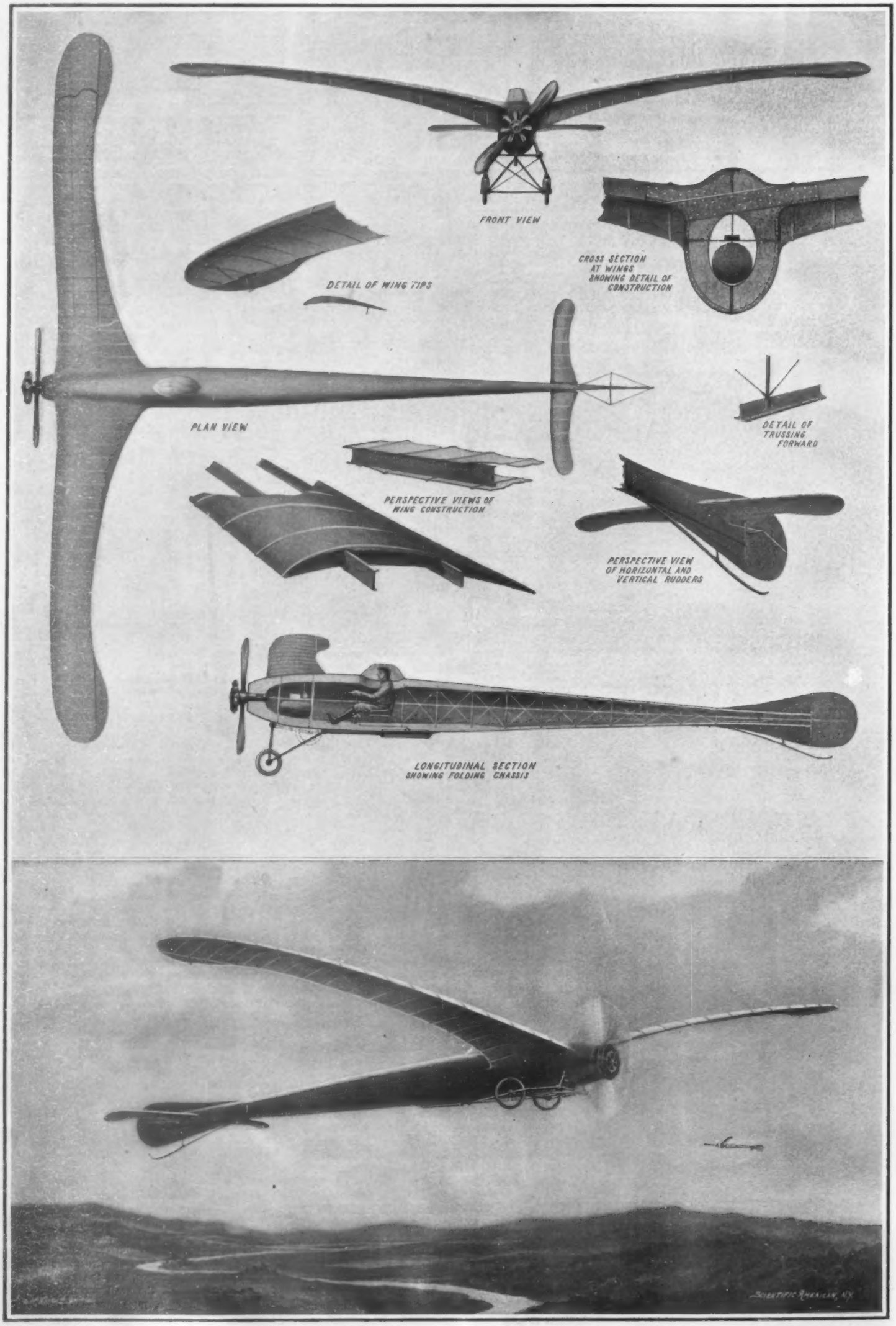
The form of wing shown in our drawings will afford a sufficiently strong construction in metal. The wings should widen considerably as they approach the body; for this would provide increasing space between the upper and under surfaces, and allow the depth of the channels to be increased proportionately to the bending stresses. These channels would be carried into the main body and riveted to transverse diaphragms, which should be so cut that the metal of the diaphragm would extend unbroken for some distance into the wings. We are convinced that by careful designing, the selection of the highest grades of steel, and by first-class workmanship, it will be possible to provide wings of ample strength without exceeding the limit of weight imposed by aeroplane requirements. Buckling in the fore and aft direction will be provided against by rolling the metal of the wing surfaces with shallow corrugations, as shown in the drawings. The main body of the aeroplane will be built also of thin sheet metal, and will be generally elliptical in cross section; two very light trusses, one horizontal, the other vertical, extending from the operator to near the tail. The chords of these trusses will be formed of light T-iron.

To provide for the heavy loads and stresses that are concentrated at the wings and motor, the T-irons of the trusses will be increased in depth and run entirely around the forward end of the body, forming, at their intersection in the nose, a strong construction for carrying the motor. Additional strength will be provided by transverse diaphragms. It is understood, of course, that all of this metal work will be specially rolled in extremely light sections, and that the material will be some alloy, such as vanadium steel, which in experimental specimens, as noted on our editorial page, has shown elastic limits running up to over 200,000 pounds to the square inch. The motor, of from 75 to 150 horse-power, according to the size of the aeroplane, will probably be of the revolving type; the Gnome motor having shown itself to be the ideal aeroplane drive.

Turning to nature for guidance again, we find that the fast-flying birds fold their legs snugly beneath them when in flight. The racing aeroplane must do the same. We show a suggested arrangement for a folding chassis, hinged just below the body, and provided with a yoke which leads from the axle up to the crosshead of a piston rod, which with the guides and cylinder is carried by the T-iron that forms the bottom member of the vertical truss. The cylinder is provided with a two-way valve and connections, by which compressed air can be introduced to the forward or after end of the cylinder. When the chassis is down and in operation, the compressed air acts as a cushion to provide a certain amount of fore and aft movement to the wheels. As soon as the machine rises, a throw of the valve introduces compressed air at the forward end of the cylinder, and the chassis is drawn up snugly against the body. A small tank of compressed air, which supplies the folding mechanism, also supplies a small cylinder of similar construction placed transversely to the car, which operates the movable wing tips. The two-way valve of this cylinder is controlled by a small gyroscope, which may be thrown out of gear when the airman wishes to make a turn, or perform other evolutions.

In answer to the question as to what speed may be expected from a machine of this general design, we think it will be agreed that, in view of its sweetness of form, the complete absence of wires, struts and other energy-consuming surfaces, and the fact that because of the smoothness of the steel surface, skin friction will be reduced to a minimum—it is conservative to expect from such a machine, after it has been developed by experimental work, speeds of from 100 to 125 miles an hour.

It would be interesting to see what Mr. Nat Herreshoff could accomplish, if he applied to the steel aeroplane the same constructive genius which enabled him to produce such fine results with steel racing yachts.


FRONT VIEW
CROSS SECTION AT WINGS SHOWING DETAIL OF CONSTRUCTION
DETAIL OF WING TIPS
PLAN VIEW
DETAIL OF TRUSSING FORWARD
PERSPECTIVE VIEWS OF WING CONSTRUCTION
PERSPECTIVE VIEW OF HORIZONTAL AND VERTICAL RUDDERS
LONGITUDINAL SECTION SHOWING FOLDING CHASSIS

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The wood, wire and canvas of the present machines will give place to steel. External wire trussing will be replaced by internal steel angles and channels, all inclosed by the thin, smooth exterior plating. During flight the running gear will be drawn up snugly against the body. With vanadium or other high-grade steel, the weight for equal power would be reduced, and the speed, because of the great reduction in head resistance and skin friction, would be enormously increased.

THE RACING AEROPLANE OF THE FUTURE. A STUDY.—[See preceding page.]

# AIR CRAFT IN WAR

## THE POSSIBILITIES OF AEROPLANES AND DIRIGIBLES

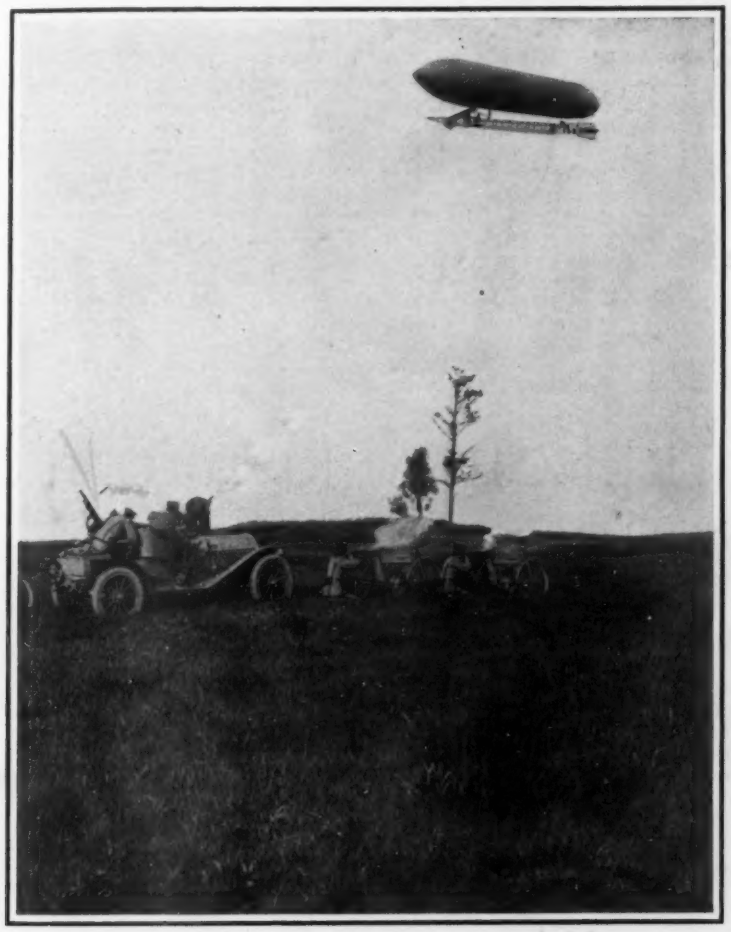
No sooner had the Wright brothers demonstrated that human flight in a controllable motor-driven machine was possible, than the important bearing of this new device upon the art of war became evident. Up to that time, the movement of naval and military forces, and the reconnoitering to determine the strength and movements of the enemy, had been carried out entirely upon the surface of the earth. Movements, whether of the individual scout, or of the army one hundred thousand strong, had hitherto been confined to the two dimensions of length and breadth. To these had now been added a third dimension, and this enormous enlargement of the field of operations was recognized as complicating to an inconceivable degree the already difficult art of war.

More important than the clash of armies upon the field of battle are those preliminary investigations and movements by which the generals of the contending forces endeavor to ascertain the numbers and disposition of the enemy. An accurate knowledge of the position and movements of the opposing army, and of the characteristics of the country in which he is operating, has frequently enabled a general to dispose his troops of the future will probably be a monoplane, capable of carrying two people, an operator and an observer, and it will be provided with a motor or motors capable of driving it at a maximum speed of 75 miles an hour or even more, this high speed being necessary to carry it with all possible dispatch to the particular field of observation. When it has reached its destination, such high speed will be no longer desirable. The machine must be slowed down, and must proceed leisurely over the country that is to be surveyed. For this purpose the machine will be provided with reefing surfaces which, folded or drawn in during the faster flight, will now be extended to afford the large supporting surface necessary to the slower speed. The observer will be provided with camera, sketching pad, field glasses, and instruments of triangulation. While he is making his sketches, notes, etc., the aeroplane will be flying slowly in wide circles at an altitude of several thousand feet above the earth, where, by virtue of its great elevation and constant change of position, it will be practically safe, even against bursting shrapnel from the larger field guns. It is not unlikely that a practicable system of wireless telegraphy may be worked out, of a character suitable for transmitting messages up to distances of say fifty to seventy-five miles, between the aeroplane scout and the headquarters of the commander-in-chief. If so, the machine will carry a third man who will continuously transmit such information regarding the enemy as may be gathered.

The enormous influence of the aeroplane scout upon field operations must be evident to the veriest novice. Had Gen. Kuropatkin been possessed of half a dozen such machines, the task of the Japanese in throwing around Mukden their huge battle lines, over a hundred miles in length, would have been enormously complicated, if not rendered impossible. Certainly the great flanking movement to the westward, in which Gen. Nogi, with 50,000 Port Arthur veterans, was able to pass entirely around the right flank of the Russian army and break in upon its rear, would have been discovered and possibly frustrated. Sheridan's famous ride would have been made through the air, and twenty minutes of time would have placed him at the desired spot. The launching of a monoplane from the forward deck of Admiral Sampson's flagship "New York" would have been followed within the hour by the discovery of Cervera's ships in Santiago harbor; and the Schley-Sampson controversy would never have left its ugly smear across the pages of our naval history.

Just how great a modification the aeroplane scout will produce in naval and military strategy it is impossible to predict; but it is certain that the opposing commanders of the future will be somewhat in the position of two chess players, each of whom has a pretty clear knowledge of what his opponent's next move must be.

Outside of its scouting duties, we are inclined to think that the field of usefulness of the aeroplane will be rather limited. Because of its small carrying capacity, and the necessity for its operating at great altitude, if it is to escape hostile fire, the amount of damage that it will do by dropping high explosives upon cities, forts, hostile camps, or bodies of troops in the field, to say nothing of battleships at sea, will be so limited as to have no material effects on the issues of a campaign. It is one thing to drop oranges upon an imaginary battleship at an aviation meet from a few hundred feet up in the air, and quite another to drop high explosives from an elevation of several thousand feet upon a warship moving swiftly upon the high seas. Certain it is that the letting go of the very limited amount of high explosives that a few aeroplanes could carry upon a city or fortification would have an effect which might amount to something in a moral sense, but would amount to very little indeed in its material effect. Military men have come to realize that the mere bombardment of cities, whether by siege guns or those of an attacking fleet, while it may be irritating and the cause of some loss to the enemy, will very rarely, if ever, prove to be a serious factor in determining the issues of a campaign.



Attacking a dirigible with automobile field guns.

Scouting aeroplane, with observer mapping the country.

THE AEROPLANE AND DIRIGIBLE IN WAR.

In such advantageous positions relative to the enemy, that the battle has been won before a single shot was fired. Hitherto, successful strategy has depended largely upon the possession of accurate maps of the country, upon the activity and intelligence of the individual scout, or upon armed reconnaissances by a comparatively small body of troops sent forward to draw the enemy's fire and obtain some knowledge of his position and strength. Of late years, the advent of smokeless powder and the high-velocity, long-range rifle have rendered the present methods of scouting extremely difficult and precarious, particularly when the opposing general has taken every precaution to preserve the secrecy and invisibility which are the very essence of successful strategy.

The advent of the aeroplane and the dirigible, however, has rendered secrecy impossible. The aerial scout must, of necessity, exercise an enormous influence upon the conduct of future campaigns, rendering the already difficult art of war perplexing to a degree that only the military man can fully appreciate.

Whatever the future may have in store, it is certain that, at present, both the dirigible and the aeroplane, and particularly the latter, will find their field of usefulness confined almost entirely to the work of scouting.

For such work the light, small, and swift aeroplane will prove to be simply invaluable. The military scout

How comparatively small would be the damage done by aeroplane high-explosive attack is suggested, if not proved, by the results of the bombardment of the Russian fleet in Port Arthur by the 11-inch siege guns of the investing Japanese army. The fire of these guns was directed by a Japanese observer on a high hill which had been captured from the Russians; and the shells, each of which weighed a quarter of a ton and carried a charge of high explosive, rained down pitilessly, with great accuracy, and almost vertically, upon the Russian ships. It is known that the whole of the Russian fleet was sunk, and it was presumed that the Japanese shells had done the work. When these vessels came to be raised, after the capitulation of Port Arthur, it was found, to every one's amazement, that the ships had been sunk by the Russians themselves, and that the damage done by the falling shells was astonishingly small. If then the falling of a 500-pound shell from a height of two miles did such little damage, small indeed would be the havoc wrought

by the Lilliputian pellets to which, because of its small carrying capacity, the aeroplane will have to be restricted.

There are, however, certain other offensive operations for which the aeroplane would be admirably adapted; such, for instance, as making raids into the enemy's country for the purpose of attacking his lines of communication, cutting telegraph wires, blowing up bridges, and making sudden descent upon commissary depots with the object of setting fire to or otherwise destroying military stores. The swiftness, silence, and unforeseen character of such attacks would necessarily render them extremely annoying to the enemy, and, now and then, a blow might be struck that would seriously affect the outcome of important military movements. A swift aeroplane would form an ideal means of transport for the aides-de-camp in carrying dispatches to various parts of the field. Furthermore, crises may frequently arise in a great battle when there is a demand for the sudden presence of the commander-in-chief, or other high ranking officer, at certain distant points of the field. The presence of two or three swift aeroplanes at headquarters might prove of inestimable advantage in critical phases of a conflict that was strung out over a far-flung battle line.

### Rules for the International Aviation Meet.

The set of rules which has been drawn up to guide the contestants in the International Aviation Meet, reads as follows:

All contestants wishing to pass another in front of them must pass to the right at a minimum distance of 75 feet and the contestant who is to be passed must keep within 100 feet of the line of the aerodrome, that is to say, the lines that connect the pylons marking the course.

A contestant who wishes to pass another shall follow the rules above stated, but shall not fly above or below his competitor. He may not pass below a contestant unless such contestant is at least 150 feet above the ground. If the contestant who is to be passed is less than 150 feet above the ground the contestant desiring to pass may, as stated above, fly to the right at a minimum distance of 75 feet or pass above him at a height of not less than 150 feet. This means that no machine may be passed either above or below except that the passing machine shall be more than 150 feet away.

Aviators are advised that when between two machines one machine tries to pass another the one trying to pass shall pass to the right. If they are close together at a curve or when nearing it it is necessary that the aviator nearest the line must follow it closely and must not crowd toward the exterior the contestant who is trying to pass him. The two aviators should take all care to avoid any accident.

At all times a machine in the air should travel in the direction opposite to that of the hands of a clock, that is, leave the towers on the left hand, and it is positively forbidden for a machine to fly at any time counter track, that is to say, in the direction of the hands of a clock, even though they be over the center of the field bounded by the posts that indicate the track.

A machine after landing for any reason within the infield on the way to its shed must cross the track as quickly as possible in the most direct line from the center of the track, and only after making sure that it will not be in the way of any other aviator.

Aviators are forbidden to fly over the public and above the stands.

All violations of these rules will subject one to penalty in accordance with the rules of the Federation Aeronautique Internationale. In the event of a second abuse the aviator may be disqualified from participating further in the meet.

### The Coming Automobile Show.

Drawing for space for the Eleventh National Automobile Show, to be held in Madison Square Garden, January 7th to 21st, 1911, is over.

Plans have been perfected by the show committee which provide the increased number of licensees under the Selden patent with space at next year's exhibition equal to that which they were able to obtain at the show of last January. At present there are eighty-three manufacturers and importers licensed under the Selden patent, and to house their exhibits will necessitate almost a complete rebuilding of the inside of Madison Square Garden, using structural steel to a very large extent. The show committee for 1911 consists of Col. George Pope, chairman; Charles Clifton, Alfred Reeves and Merle L. Downs, secretary.

The first to draw for space was the Buick, followed by the Overland, E. M. F., Cadillac, Packard, Maxwell, Chalmers, Reo, and Pierce-Arrow. The other cars which will occupy space on the main floor are as follows: Stearns, Thomas, Oldsmobile, Franklin, Dayton, Oakland, Lozier, Elmore, Winton, Locomobile, Hudson, Mitchell, Stevens-Duryea, and Peerless.

Cars in the exhibition hall and balconies will include the following makes: Amplex, Moon, Mercer, Corbin, Bartholomew, Nordyke and Marmon, Knox, American, Matheson, National, Selden, Buckeye, Moline, Premier, Autocar, Columbia, Alco, Studebaker, Waltham Inter-State, Ohio, Palmer and Singer, Kissel, Hol-Tan, Chadwick, Speedwell, Regal, McIntyre, Marquette, Acme, Pierce-Racine, Flandrau, Hupmobile, Midland, Brewster, Courier, Simplex, Atlas, Dorris, and Cartercar.

The forthcoming national show will be divided into two parts, one of which will be devoted entirely to passenger or pleasure vehicles. This will be known as Part One, and will be held during the week of January 7th to 14th. Commercial or freight-carrying vehicles, electric carriages, and motorcycles will be exhibited in Part Two of the show during the period of January 16th to 21st, inclusive. Comprehensive display of accessories will be exhibited at both periods.

In the near future a meeting will be held at which will be allotted space to the accessory dealers and exhibitors of commercial or freight-carrying cars, electric vehicles, and motorcycles which will comprise Part Two of the show.

A queer fellow is the secretary bird in several respects. Not only has this creature of the feathery tribe large wings for the size of his body, which enable it to ascend to a great height, but it has long legs as well, which permit it to scamper over ground at a great rate of speed. It has been likened to the ostrich in its fleetness of foot, and to a balloon in its flight. Another peculiar thing about this strange bird is that it builds its nest, not on the ground like other long-legged birds, but in a tree. It lives in the same nest year after year, subsisting on small mammals and snakes, the latter being its choice. It derives its name too in an odd way, which is for the reason that the tufts of feathers which grow on either side of its head look precisely like a bunch of pens or pencils stuck behind a clerk's (secretary's) ears.

# LEARNING TO FLY ON FRENCH AERODROMES

BY W. F. BRADLEY

Pau, Croix d'Hins, Mourmelon. To the average man they are merely names, evoking no memories and having no significance. Yet it is in these places, unknown yesterday, interesting to-day, and famous to-morrow, that a new race of sportsmen is developing. It is at Pau, Croix d'Hins, and Mourmelon that men are being taught to fly, and the secret of the birds is gradually being mastered.

Formerly, aeroplane pupils were given a few verbal instructions, and sent away alone to do their best. Such a method is most unsatisfactory for teaching a bicycle rider or a swimmer; how much more so for the navigation of the air, in which art even the most expert are only learners! The advantage of the Wright machine, on which the pupil occupies a seat by the side of the professor, was quickly realized by European constructors, and in nearly every case provision has been made for the pupil to mount with the pilot. On such small machines as the "Blériot XI". and the Santos-Dumont "Demoiselle," incapable of lifting an extra person, other arrangements have had to be made. Thus, the Clement Company, which now builds the Santos-Dumont type, has an aeroplane without wings, with which the pupil runs over the ground until he is quite familiar with all the controls, and has learned exactly the amount of effort required to operate the lateral rudder.

All the other firms have specially prepared machines for the use of pupils. For instance, the Voisin Company has what is known as the "taxi," an aeroplane closely resembling its ordinary product, but with its power and angle of incidence so regulated that it would be impossible for even a Paulhan to remain aloft with it for many minutes. It is on this type of machine that pupils run over the ground, first to familiarize themselves with the controls, then later to fly when passing over descending ground. It is only when they can fly the maximum of a kilometer rendered possible with the taxi that the pupils take their own machines and attempt longer flights. Occasionally, when he finds a properly balanced machine in his hands and has a more powerful motor behind him, the inexperienced flyer will attempt to rise up literally "like a lark," only to fall back with a mass of wreckage around him. Generally, however, he has profited by his lessons sufficiently to continue his training progressively without any mishap. There are at present at least a score of young aviators who have made not less than one hour's flight and never broken a spar during their apprenticeship.

Henry Farman's method is to mount with his pupil occupying a higher seat immediately back of him, in which position the pupil can watch closely all the movements of his instructor, and after a few lessons be able to run over the ground in a correct way. When the first trip is made with the pilot in the passenger's seat, the wise precaution is taken of either limiting the power of the motor, or so setting the rudder that it is impossible to rise more than a few inches. After a few rounds of the course have been made in this manner, the pupil takes a normal machine, and makes his first attempt at flight alone in a still atmosphere.

Hubert Latham, being seated in a cockpit only wide enough for one person, is obliged to place his pupil in front of him, and by means of a double set of steering wheels control his movements whenever necessary. The Blériot passenger-carrying type of aeroplane shares the advantage, with the Wright, of carrying teacher and pupil side by side, thus allowing instruction to be given very easily, and permitting the fitting of double control levers. All the latest Voisin biplanes are also built with a framework so wide that the pilot can carry a passenger immediately on his left; thus for training, the pilot handles one set of levers and the pupil a duplicate set.

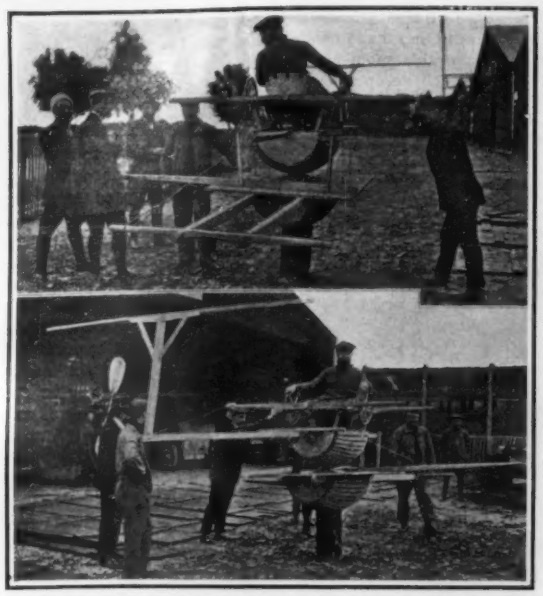
Probably the thought will occur that it is a dangerous game—learning to fly. One might reasonably think so, but there are facts to prove the contrary. Instructor Chateau, of the Voisin Company, estimates that in six months he traveled between four thousand and five thousand miles on the "taxi" with various pupils by his side, and during that time never broke a spar. Henry Farman and his assistant, Van den Born, can make similar claims for the biplane they employ for training pupils. On a moderate estimate, between two hundred and three hundred pupils have passed through the European aviation schools without a single serious accident.

Yet smashes do occur, and there is always plenty of work for the repairmen at the schools. Carried away by enthusiasm or forgetful of the instruction he has received, the pupil often meets with disaster during his first few flights alone, yet in none of these accidents has any serious injury befallen the pilot. The theory of the builders is to so place the driver that there will be wood and metal all around him, to protect him in case of a fall. A glance at the pilot's position in the Antoinette or the Hanriot—the most perfect machines in this respect—will show that in front the motor and fuel tanks must be demolished before the pilot can be touched, the wings protect on each side, and in case of a vertical drop, which however is practically impossible, there is a stout running gear and landing chassis underneath.

Activity commences early in the day at the flying schools, and does not cease until sunset. The enemy is wind and rain, but such progress is being made that a breeze which would have kept every aviator indoors only a year ago is considered of no importance now. The consequence is that although learners may have to wait for the most suitable meteorological conditions, there are now very few days in the year on which nobody will venture forth. This is particularly true of Pau, which by reason of its situation is sheltered from strong winds. Mourmelon is more exposed and not so favorable for novices, but frequently learners who have received only half a dozen lessons fly over the exposed plain in a wind of 10 to 15 miles an hour; yet, only two years ago, Henry Farman would wait a whole day for a gentle breeze to die down to a mere zephyr.

If the sight of a single aeroplane flying over the ground is monotonous after the first fifteen minutes, the spectacle of half a dozen machines out together is intensely fascinating. One by one they are wheeled out of their sheds, monoplanes and biplanes of various types; the pilot mounts into his seat, an assistant starts up the motor by swinging on the propeller, and, leaving a hurricane behind, the big structure scutters away to rise after an initial run of a couple of hundred yards. Another and then another follows until there are a dozen or more sweeping around the course, some at a great height, some near the ground, and others content to run over the surface.

The transformation is the most remarkable after a shower or following a drop in the wind. The ground, which has probably been deserted for the entire day, suddenly becomes alive with flying machines and their pilots, all hastening to get into the air before twilight falls. There is a poetical charm about the scene as one stands on the ground and watches the aeroplanes pass directly overhead. The pilot in a slightly bent position operating his levers and steering wheels with the same leisurely movements as a yachtsman at the



Antoinette machine for the instruction of aviators.

Farman with two passengers on his new biplane.

The dragon-fly of the twentieth century. An Hanriot machine in flight.

1. Morane with two passengers at Rouen. 2. The control lever and wheel of an Hanriot monoplane. 3. Louis Wagner starting in his monoplane.

Baroness Delaroche in her biplane.

Farman instructing a pupil.

Latham at the wheel of an Antoinette.

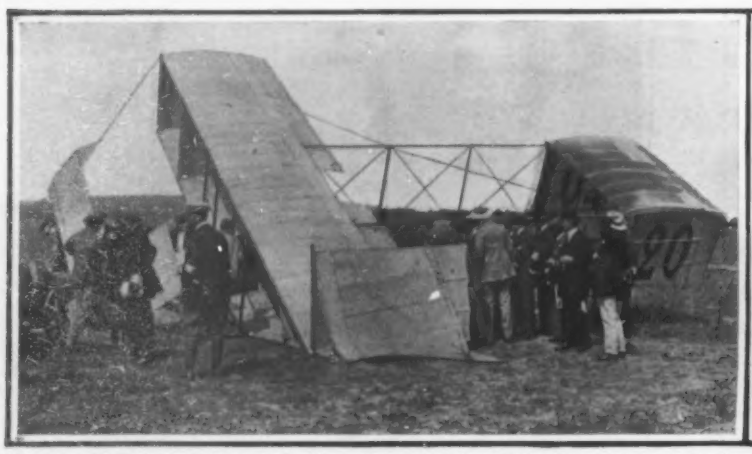
LEARNING TO FLY.

tiller; the muffled exhaust of the motor; the delicate forms of the machines, and the rapid easy motion without shock or jar, all fire one with an enthusiasm to mount aloft and soar with the freedom of the birds.

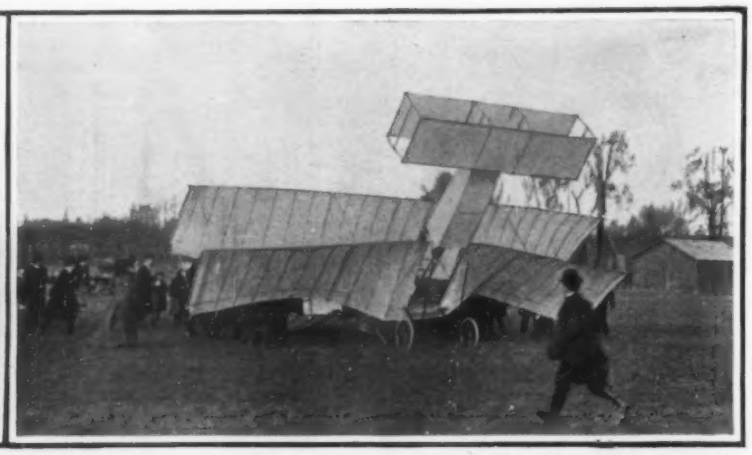
It is when the aerodrome is crowded and there are several learners about, that the greatest precautions have to be taken to avoid accidents. The rule of the air is that all shall fly around in the direction of the hands of a clock, and that one machine desiring to pass another shall keep to the outside of the course or pass overhead. These elementary rules are so closely observed, that there is little fear of a collision in mid-air. But it is when starting or running over the ground that accidents are likely to happen. A pilot passes directly over another machine just about to leave the ground, and the powerful backdraught from his propeller upsets the equilibrium of the lower apparatus. Or an aviator will pass a slower companion at the same level and cut in front of him too early, again causing a disturbance of the air that is not at all to the liking of the follower. As the aeroplane loses speed when landing, it is less under control than when in the air. Many aviators forget this, and at the same time miscalculate their speed and distance, with the result that they find themselves running over the ground, the motor stopped, but unable to pull up until they have demolished other machines awaiting a favorable moment to start. There are no brakes on French aeroplanes.

Planeless machine for instructing Santos-Dumont beginners in use of control mechanism.

Sometimes, owing to overheating, the motor refuses to stop when the ignition is switched off, and before the gasoline supply can be cut off, a collision is inevitable if space is at all restricted. This is what happened to the late Capt. Ferber on one of his last flights over an aerodrome near Paris. A bar was immediately ahead of him, and it was into this establishment that he crashed, to the terror of the barmaids and to the sound of hundreds of broken glasses. The captain coolly climbed from the wreckage with the remark, "I have won my prize, any way." Another aviator stepped out of his machine without taking the precaution to cut off the ignition, with the result that the motor started off again "on the spark," and the aeroplane became a runaway. After all, these are only the gayeties of the aerodrome, costly, it is true, to the participants, but highly interesting to the spectators.

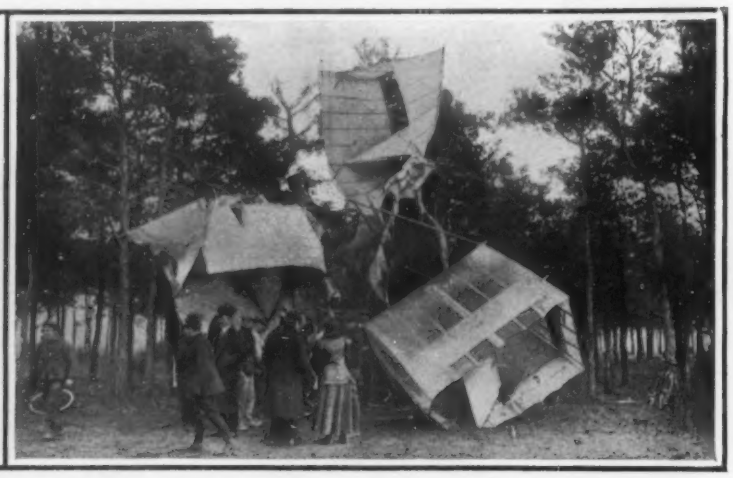


Wreck of a Voisin biplane at Betheny August 27th, 1909. The picture indicates that imperfect lateral stability probably caused the accident.



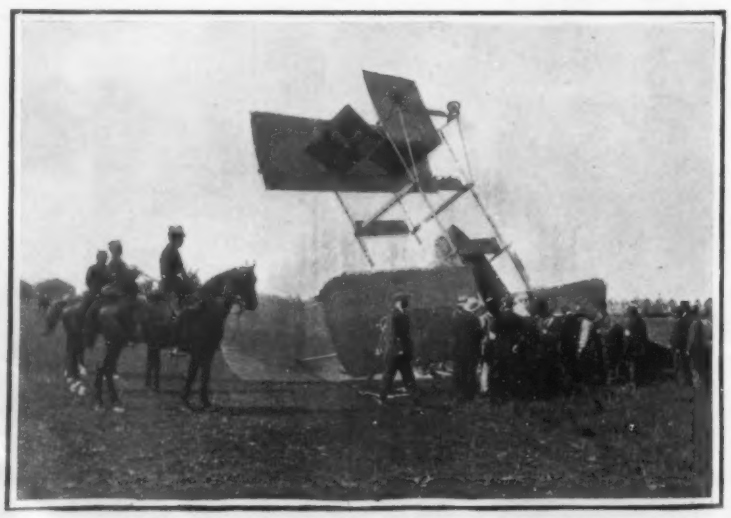
One of Delagrange's biplanes after a smash-up. The aviator was afterward killed in a monoplane.

Hauvette Michelin's machine at Heliopolis, Egypt. Michelin was killed recently.



De Baeder's machine. Artificial birds were not meant to perch on trees.

A wrecked Farman machine at Brooklands.



Breguet's biplane after a luckless downward plunge.

LEARNING TO FLY.

# Correspondence.

### POE'S "EQUILIBRATOR."

To the Editor of the SCIENTIFIC AMERICAN:

I should like to take an exception to a statement of yours in the October 8th number. You say that Wellman's equilibrator is a new or original proposition. Now in E. A. Poe's "Balloon Hoax" (vol. 1. Tales, page 99), he uses a guide rope with weights for the same purpose. Mr. Wellman may have copied this feature from Poe.

G. H. FISKE.

Cambridge.

### TO EXPEL A PROJECTILE STUCK IN THE BORE.

To the Editor of the SCIENTIFIC AMERICAN:

I read some few days ago that a new breech block had been fitted to the 12-inch rifle which exploded with such fatal results at Fort Monroe, and that efforts were being made to expel the projectile, which was stuck about 10 feet from the breech, with small charges of powder. This method was strictly in order with the smooth-bore muzzle-loaders using spherical shot in the old navy. In the case of a rifle breech-loader, a simple, safe, and quick method can be used. A stick of clear dry white pine is turned down to fit the bore easily (not the grooves). Insert into the gun the forward end snugly against base of projectile, the rear end resting on the charge or one-half charges; the 25 or 35 feet of bore the shot has yet to travel being generously lubricated. Close the breech, and fire the gun without danger to gun or crew more than if the projectile rested on the charge. The breech has simply been moved forward to the projectile. With the described material on hand and a new breech or parts, any gun under similar circumstances can be again in action in a very short time. I send a crude drawing showing gun closed ready to fire.

Ames, Okla. W. B. WILLIAMSON.

### THE EXTINCTION OF OUR MERCHANT MARINE.

To the Editor of the SCIENTIFIC AMERICAN:

Your recent editorial on "The Extinction of Our Merchant Marine," closing with the question, What are we going to do about it? induces me to offer a suggestion.

The cause of the decline of our ocean carrying trade is undoubtedly the higher price of labor in this country, coupled with the necessity of submitting to absolutely free competition with the whole world while engaged in that trade.

Almost the only proposed remedy is that of ship subsidies, but the difficulty with these is that they do not exclude competition, but are themselves a means of competition. What is wanted is a device which, while encouraging free competition among the ships of any one nation, will exclude competition between the two nations. Such a device could be arranged as follows:

Put a compensatory tariff on all incoming traffic in vessels of the country from which it comes, and a prohibitory tariff on all incoming traffic in vessels of other nations than that from which it comes.

For the sake of clearness, suppose that where the gross earnings of an English vessel are $1,000, an American vessel must have $1,400. Then put a compensatory tariff of $400 on each $1,000 worth of the incoming traffic from England in English vessels, and a much higher tariff on traffic from England in other foreign vessels. This would protect our vessels on their incoming traffic, but they would still need protection on their outgoing traffic. This could be provided by issuing certificates to American vessels bound for England, which certificates would be computed on the outgoing traffic in the same way as the tariff on the incoming traffic, and would be redeemable at our Treasury out of the fund provided by the tariff on the incoming traffic *from England only*. Or, these certificates would be accepted *from English vessels only* in payment of their tariff, which would make them readily salable in English ports.

This scheme would work to automatically divide the carrying trade equally between the United States and England. For, since the tariff alone would be but half enough to compensate our vessels for a round trip, each American vessel would have to have an incoming English vessel to purchase its certificate. England would have no cause of complaint so long as she got her half of the carrying, and the matter of adjusting the tariff so as not to interfere with her rights would be a simple matter, as there would be a wide margin ($400 in the supposed case) between a tariff barely sufficient for us and one that would be so large as to compensate our vessels without the use of the certificates.

Of course, if there were an excess of exports over imports, as there undoubtedly is in the case of the United States with England, the excess of exports would not be affected by this scheme. They would still be carried in the cheaper English vessels, which would not be objectionable, since one of the main reasons for encouraging our merchant marine is the necessity of stopping a very considerable drain upon our circulating medium. And since our export trade is our greatest source of monetary income, it would not be unwise for us to encourage that trade by giving the carrying of it to the nation producing it.

The advantages of this scheme are (1) it would relieve us from any costly competition in securing our just share of ocean traffic, (2) it would not cause one dollar of drain on our Treasury, (3) it would build up our merchant marine promptly, and (4) it would, unlike any mere ship subsidy, assure *continued* protection to our ocean carrying interests, a matter of the greatest importance.

The only possible objection that could be raised would be the added cost of imports to American consumers. But this could not be greater than in the case of ship subsidies, and would certainly be far preferable to an exhaustion of our circulating medium.

Hettinger, N. D. N. J. NOBLE.

### ERASING INK LINES ON TRACING CLOTH.

To the Editor of the SCIENTIFIC AMERICAN:

A few weeks ago there appeared among your notes of scientific interest a brief mention of a labor-saving device consisting of a rotary eraser driven by an electric motor for making erasures on drawings. The tracing linen on which shop drawings are nearly invariably made is particularly vulnerable to the attack of any instrument for removing the lines mechanically; and apart from the cost of an apparatus of this kind, there is a decided advantage in a method that will remove the greater part of the ink without abrading the linen.

Rubbing the tracing with a cloth moistened with a solution of gum camphor in alcohol will do this in quite a satisfactory manner. A little firm rubbing, though not entirely removing the lines, leaves them so thin and transparent that a comparatively slight application of a soft rubber completes the erasure, and leaves the surface in a far better condition than if removed by mechanical means alone.

Possibly other solutions would answer the purpose as well, but they must not be aqueous solutions; for, as every draftsman knows to his sorrow, the sizing on tracing linen is soluble in water. It would be interesting to know the precise action of the camphor in solution upon the dry ink line. The action appears to be physical rather than chemical, and to depend upon the conditioning of the ink particles for easy separation by the rubbing operation. Perhaps chemists who have made a study of flocculation and deflocculation may be induced to explain this.

Philadelphia, Pa. LUCIAN E. PICOLET.

### THE CONTAGIOUS DISEASES OF METALS.

To the Editor of the SCIENTIFIC AMERICAN:

I notice with much interest an article in the SCIENTIFIC AMERICAN of June 25th, entitled "The Contagious Diseases of Metals."

Here, on the southeast coast of China, we often have in the summer long spells of very damp weather. Sometimes the salt in an open salt cellar will dissolve itself in the water which it secretes from the air; and of course we are much troubled with iron things rusting. We sometimes see in little Chinese shops bright wire nails in tightly stoppered bottles; for thus only can they be kept bright.

I have come to the conclusion that this rusting is due to some sort of germ that settles on the iron, grows by secreting moisture from the air, and rusts the iron by means of this moisture.

The first thing I noted was that this rusting does not attack the iron uniformly, but begins sporadically at certain points, and spreads from these like lichens on the bare face of a rock.

Next, on opening a package from home which contained a new knife, I found on the back of one blade several single threads of rust, starting from the back and running toward the edge in winding courses. Under a magnifying glass each thread looked like a string of minute beads, oval shaped and truncated at the ends where they joined on to each other. I have had several cases of this kind. In some threads the beads were of uniform size throughout; in other cases they tapered uniformly to at least half the original size before the end was reached.

In the case of books sent by mail, with thin bits of metal in the wrapping to protect the corners, there would usually be patches of rust on the bits of metal, each spreading outward from a center; thicker at the center and thinning out irregularly toward the edges. The appearance under the glass often seemed to be that of [illegible] such centers, with the threads confusedly intermingling. If a book were left unopened for several months, the rust would secrete enough moisture to soak through the paper wrapped about the bits of metal, and stain the corners of the book covers.

Once in the case of some pocket knives with wooden handles, there was a minute drop of rusty water on the ends of each rivet, or else a rust stain extending through at least two thicknesses of the wrapping paper. Yet there were no other signs of moisture except a thread of rust here and there on the blades.

I might multiply instances like these; both of dry rust and of wet rust, in clocks, and even in watches, and of threads of rust burrowing under the silver surface of plated steel knives.

There was one case especially that gave me a fair opportunity of putting this germ theory to the test. A "Little Joker" clock that had run well for nearly twenty years, at last refused to go, soon after the beginning of the rainy season; and the trouble was found to be rust in one of the little steel cups in which the points of the balance wheel run. Three times it was cleaned out, polished and oiled, only to fill up again with rust. Then I took out the two cups and the balance wheel and boiled them in a light oil; and since then the clock has passed through several wet seasons with no return of the trouble. The little steel cup had become infected with rust; boiling in oil had killed the infection, and ended the trouble.

The rusting is due to something which causes the secretion of moisture from the air; it has a secretive potency like that of salt; and it is something which begins at minute centers, and grows outward from these. What but living germs could produce such results?

It may be that this rust plant secretes something more corrosive than water; but there is no visible evidence of this. There may be more than one kind of rust.

I have several times called the attention of microscopists to these phenomena, but have failed to interest them.

J. E. WALKER.

Foochow, China.

### How the Wellman Airship is Electrically Lighted.

Equipping an airship with a complete lighting system, telephone system, and wireless outfit is not an everyday affair with the average electrical man, for which reason a description of the plant which has just been put aboard the Wellman-Vaniman trans-atlantic dirigible "America" may prove sufficiently unusual to be interesting.

The two main difficulties in designing the installation were the necessity for perfect insulation and flexibility of the generator. The insulation problem arose from the fact that the steel frame of the ship serves as the aerial of the wireless station. The other difficulty was caused by the necessity of providing against the stoppage of any one or two of the three engines, in which event the generator would have to be moved and connected with a live engine. To procure adequate insulation, a special conductor was specified, consisting of B. & S. No. 8 gage stranded copper covered with a fine asbestos shield and immersed in rubber solidified to a coating of ⅛ inch thick. This was then spun with jute to give tensile strength, and the strands woven, incased in fabric, and treated to fireproof solution. On puncture test this insulation withstood 26,000 volts between potentials. The flexibility of the generator entailed the building of three frames, one at each engine, and providing three sets of pulleys and belts to secure the proper speed at each engine. To devise adequate circuits to take care of this portable feature, multiple cable was run from the forward to the aft engine, and a double-throw switch installed, so as to open this multiple at such times as the generator is being operated for reverse position, thus avoiding all chance of grounding on the frame.

The Marconi apparatus is operated in multiple with the lamps, and the fluctuation, which is comparatively slight owing to the small current (250 watts), is taken care of by the use of extra heavy copper. The circuit is so devised that, should the battery fail, both the wireless apparatus and the lights can be operated from the generator direct. The main switchboard is located midway between the two main engines. In addition to the switchboard instruments, however, the wireless operator is supplied with special Keystone instruments to note his discharge, and the generator will of course be run only upon his instructions.

The lighting equipment consists of eight 20-volt, 25-watt Buckeye mazda lamps in steel reflectors located in the nacelle over the working platform. A lamp is provided for the binnacle, one for log, one over each of the three engines, two at the observation cabin in the stem of the ship, and one in the lifeboat for the wireless operator. The lamps are burned at somewhat more than their rated voltage, as the transatlantic trip will be short, and it is desired to secure exceptionally brilliant illumination for short periods. On this account also reflectors were employed to increase the efficiency to the maximum.

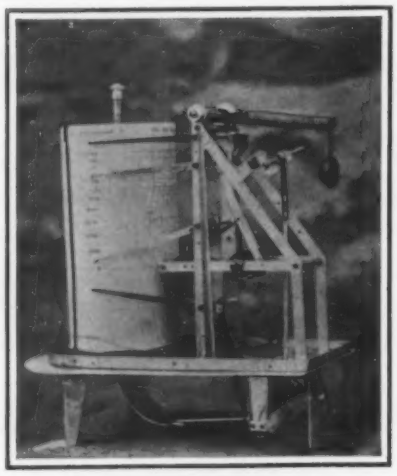
As may well be imagined, the wiring of the "America" was a most careful piece of work, every foot of conductor, every joint, and every connection being tested independently by both the engineers in charge.

To matt aluminium immerse the object in strong soda lye until gas bubbles form copiously on its surface, rinse it, lay it in strong nitric acid, and rinse it again. The object will by this means be given the appearance of matt or frosted silver.

# THE ATMOSPHERIC OCEAN

## BY PROF. A. LAWRENCE ROTCH, DIRECTOR OF BLUE HILL METEOROLOGICAL OBSERVATORY

The navigation of the air by balloons and aeroplanes has extended the interest in the nature of the atmospheric ocean, hitherto confined to meteorologists. It is a striking fact that whereas the winds above and the currents in the seas were long ago determined for the benefit of navigators, the upper air conditions have been investigated purely from a scientific standpoint and only systematically within the last twenty years. About 1890 scientific balloon ascents were begun in Germany, and two years later balloons equipped with automatic instruments attained great heights in France. In 1894, the first kites were employed at Blue Hill to lift self-recording instruments for the purpose of ascertaining the meteorological conditions prevailing in the free air at different heights above the ground. In order to utilize to the best advantage these various methods of exploring the air, there was formed at Paris in 1896 the International Commission for Scientific Aeronautics with headquarters in Strasburg. The scope of its work has gradually been increased, so that some thirty government and private stations in various parts of the world now make simultaneous observations with kites and balloons once a month. In addition, expeditions have been sent to both northern and southern latitudes, and the atmospheric conditions at high altitudes over the oceans and continents studied for a longer time. The observations are centralized and published monthly in Strasburg, and this material collected solely to increase our knowledge of the atmospheric circulation cannot fail to be useful also to aeronauts. The stations in America which co-operate in this work are the Mount Weather Observatory of the United States Weather Bureau on the Blue Ridge, in Virginia, and the writer's observatory on Blue Hill, near Boston, and the results at the latter will be chiefly quoted in this article.



This instrument, weighing two pounds, records barometric pressure, temperature, relative humidity, and wind velocity.

**Fig. 1.—The meteorograph.**

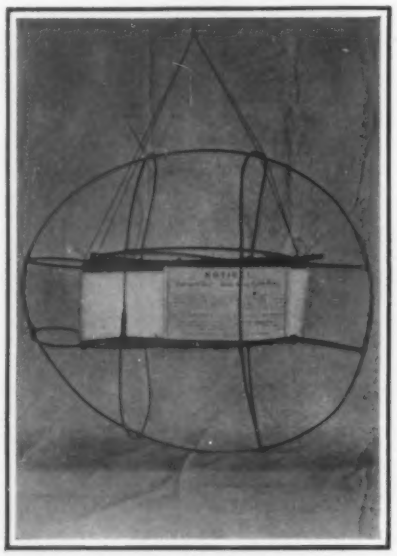


**Fig. 2.—Method of protecting meteorograph from weather and rough usage.**

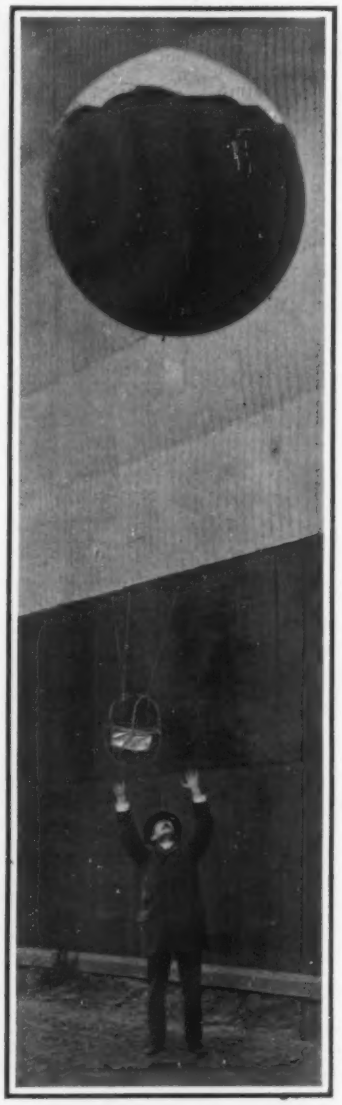


**Fig. 3.—Sending up a "sounding balloon" with meteorograph attached.**

First, we will consider some general characteristics of the atmosphere. At the outset it should be noted, that while only on mountains can continuous observations at a considerable and fixed height be conducted, yet such observations, even if made on mountain summits, do not represent the conditions at an equal height in the free air. Consequently, to obtain them, it is necessary for man to ascend into the atmosphere, or, as is generally done to-day, to send up instruments that attain heights double, or treble, those which he himself can reach. Fig. 5 represents a vertical section of the atmosphere which lies within twelve miles of the earth, and contains eleven-twelfths of the whole mass of air. Meteorologists are only concerned with this portion, because all the atmospheric disturbances occur well within it, and it is certain that aeronauts will never rise to its upper limits. In fact, the greatest height to which man has ascended in balloons is seen from the diagram to be but little over six miles, while on mountains he has climbed to a height of less than five miles. The reason for these limitations is the increasing rarefaction of the air, for it is also seen from the scales on the borders of the diagram, that the pressure is halved for about each three and a half miles of ascent, though this distance, owing to the decrease of temperature, diminishes with the altitude. Registration or sounding balloons have reached in America the height of twelve miles, and in Europe the extraordinary height of eighteen miles, where the atmospheric pressure is only a fraction of an inch of mercury, instead of thirty inches,

This shows, to the right, a kite ready for an ascent; to the left, the engine-house and gear for winding in and out the kite wire; a theodolite; and a meteorograph ready to be attached to the kite.

**Fig. 4.—Kite plant at Blue Hill Meteorological Observatory.**

under which we breathe at sea-level. Kites can be employed to give detailed data up to four miles, while clouds and balloons furnish information about the air currents very much higher. The average height of the cirrus cloud is about six miles in our latitude, and it moves on the average about 80 miles an hour from a westerly direction, as does the whole upper atmosphere, except at the equator, where the drift is from the east.

Fig. 5 shows the distribution of temperature over the globe, so far as known. The line of freezing temperature, which touches the earth near latitude 60 deg., rises more than three miles above the equator. The temperature however continues to decrease with height, and ten miles above the equator is some 180 deg. F. lower than at the surface of the earth. In fact, this temperature of —100 deg. F. is lower than is found at any height in northern or southern latitudes, for the reason that over the equator the temperature ceases to decrease at a greater height than nearer the poles. So the line marking this change of condition is seen to rise above the equator, separating the low average temperatures indicated from the upper stratum of nearly constant temperature and variable winds, which extends to an unknown height, certainly exceeding eighteen miles. The cause of this isothermal stratum is not definitely known, nor has it any practical interest for the aeronaut, since this rare and intensely cold air will forever form an impassable barrier to all animate creatures.

We will describe next how the data are obtained at Blue Hill Observatory. Fig. 4 shows the kite-plant prepared for a flight with the registering instrument, or meteorograph, ready to be attached to the kite-wire. This instrument, seen uncovered in Fig. 1, though weighing only two pounds, records barometric pressure (from which the height is calculated), air temperature, relative humidity, and wind velocity; and these data being continuously inscribed on a revolving clock drum, can be correlated as regards time and altitude. Additional kites are clamped to the wire as the height and weight increase, and they are drawn in by a steam engine, which operates a windlass having devices for measuring the amount of wire out and the strain to which it is subjected. In this way data are quickly and surely obtained for hours at a time at a nearly constant height up to several miles above the station on the ground. An historical account of the work here and abroad appeared in the SCIENTIFIC AMERICAN, August 10th, 1907.

While attended by greater losses, both of time and material, the so-called sounding balloon must be used to obtain temperatures, and approximately the direction and speed of the air currents at great heights. One of these balloons being sent up from St. Louis, where the first experiments in America were made in 1904 by the Blue Hill staff, is shown in Fig. 3. A detailed description of their use may be found in the SCIENTIFIC AMERICAN, February 27th, 1909, and it will suffice to say that the balloon is made of sheet-rubber and closed after being filled with one hundred cubic feet of hydrogen gas. To a parachute covering the upper portion hangs below the balloon an instrument which records the barometric pressure and temperature. This apparatus is lighter than that carried by the kites, and to obviate freezing of the ink at the extremely low temperatures encountered, the record is made by a stylus on a smoked sheet of metal covering the clock cylinder. The balloon rises until the expansion of the contained gas bursts the rubber envelope, which, with the instrument supported by the parachute, sinks to the ground, often several hundred miles from its starting point. By means of a notice and a small reward to the finder the instrument, with the graphic record of temperature and height, protected from rough usage and exposure to the weather as shown in Fig. 5, was recovered in 72 out of 76 instances when dispatched from St. Louis. These balloons, and others without instruments, are followed with a surveyor's transit until lost to view, and in this way the direction and velocity of the wind up to ten or twelve miles may sometimes be ascertained in clear weather. At night, or in cloudy weather, the place where the sounding balloon fell, and the length of time it was in the air, as shown by the automatic record gives the resultant drift of the upper currents. Sounding balloons can also be used at sea provided two are coupled together, for when one bursts and drags its twin slowly down, the full balloon supports the instrument in the water, and floating at a considerable height serves as a beacon to guide the steamer to its recovery.

From the point of view of the aeronaut the wind is the most important element in the atmospheric ocean. First, as regards its velocity. At Blue Hill the mean velocity, which is 16 miles per hour, increases most just above the Hill owing to withdrawal of friction at the ground, but it continues to augment up to a great height. The following figures may be considered typical of wind conditions in the free air over most of the United States. At a third of a mile above sea level, the velocity is 22 miles per hour, at a mile 29 miles, at two miles 34 miles an hour, at three miles 50 miles, and at six miles 81 miles per hour. The annual range increases fast with height, so that the velocity of the upper winds in winter is more than double their summer speed and may sometimes exceed 200 miles an hour. The wind velocity also increases nearly twice as fast at night as in the day time up to about a third of a mile, when the velocity decreases (except in winter) up to three-quarters of a mile. Since the highest velocity at low levels is in the afternoon, the conditions only a short distance above the ground are completely reversed. The winds in our latitudes change their velocity and direction with the movements of the areas of high and low barometer, but whatever the direction of the surface wind it tends to become westerly at a height of a couple of miles, the southerly winds at the surface generally turning to the right and the northerly winds to the left. In the tropics, the trade-winds blow steadily from the northeast north of the equator and from the southeast south of it. An expedition sent jointly in 1905-6 by M. Teisserenc de Bort and the writer to explore the atmosphere above the tropical Atlantic from a steam yacht, demonstrated that above the trades, as was to be expected, the wind generally changed direction, so that above the northeast trade it turned, either in a right or left-handed direction, to the southwest, and above the southeast trade it became northwest. The height of this reversal varied greatly, and near the equator the wind was east at all heights. Prof. Hergesell found the counter-trade in the Caribbean Sea as a very strong southwest wind three miles above the northeast trade-wind at the surface. The prevailing winds at different heights over the globe are indicated in Fig. 5.

The practical importance of these considerations to

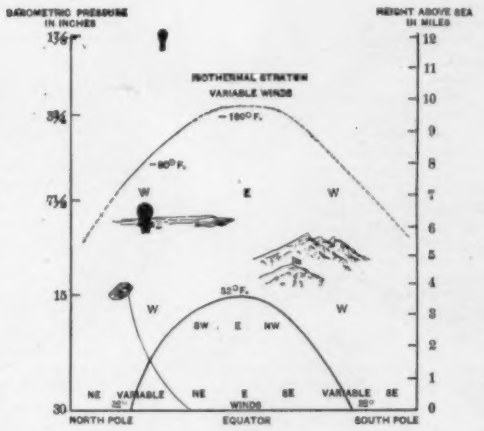



**Fig. 5.—Vertical section of the atmosphere.**

aeronauts is obvious. Aerial craft, both heavier and lighter than air, cannot tack like ships, because they drift bodily with the current in which they are immersed, and to advance against it they must have a speed greater than that of the wind. Therefore, they should seek the level at which favorable currents are known to prevail. Near the ground the wind is more gusty, on account of the obstacles which it encounters, and during the daytime irregular ascending currents are felt, whenever there is little wind, up to the height of a mile, where the cumulus clouds are formed. Supposing a dirigible balloon to possess the speed of at least 20 miles an hour, it would be truly dirigible at low levels in the vicinity of Boston on one day in two during the winter half year and on five days in six during the summer season. If the average speed exceeded 30 miles an hour, it could be used almost every day in summer and be hindered one day in six in winter. The safety of aeroplanes would, however, be endangered by winds exceeding 20 miles an hour, especially if gusty. Certain high-level routes across the Atlantic appear advantageous, provided the air craft can remain several days in the air at a height of two or three miles. By utilizing the prevailing westerly wind at this height Europe might usually be reached in less than four days and the return made from northern Africa to the West Indies by the northeast trades in about the same time, even if no motive power were used. By ascending sufficiently high, the southwest counter trade would probably make possible the eastward passage between the West Indies and Teneriffe or Madeira.

Such information about the atmospheric ocean can be furnished the aeronaut by the aerologist—as the explorer of the air, who remains on the ground, is called —in the same way that the hydrographer has surveyed the seas for the benefit of the sailor.

### New York's Annual Electrical Show.

An average of from fifteen to sixteen dollars per year per individual is spent in the United States for electricity, according to a conservative estimate of Mr. T. Commerford Martin. Of course, the vast majority of the population spends practically nothing for electrical service, except in the way of trolley fares, telephone tolls, and the like. Indeed, most of the $1,500,000,000 representing the amount paid for electrical service may be accounted for in lighting and power industries, and telephone and telegraph service. Nevertheless, there is a large and growing use of electricity in the household, which is assuming such proportions that we may well call ours the electrical country. The annual exhibition of electrical appliances in this city has for its object to educate the public in the use of electricity, particularly in the home. For this reason, the present exhibition, running from October 10th to 20th, devoted nearly half of its floor space to domestic appliances of all sorts, taking in practically every class of work done in the domestic workshop and showing how much more neatly and expeditiously the labor may be performed by the use of the electric motor and electrically-heated utensils. Particularly noticeable in this connection was the large number of vacuum cleaning machines, ranging from the small portable ones, weighing but twelve pounds, to large permanent installations for heavy work. There were no less than eight exhibitors of vacuum cleaners out of the seventy-five odd in the entire exhibition, while there were as many more booths devoted to electrically-heated cooking utensils.

Here the housewife was shown how a spring chicken may be broiled for two and a half cents' worth of electricity; how creamed oysters can be prepared for one and three quarters cents; how a Welsh rarebit may be made for a cent and a half, and how the griddle may be kept hot and in working operation for an hour and a half at a cost of but two and a half cents. Not only light cooking, but elaborate meals may be prepared on the electrical stove at small cost, with no danger of overheating the house in summer time, and with practically no odor, because the majority of the utensils are operated on the fireless cooker principle, in which the vapors are largely confined during the cooking operation. For the worried housewife who is troubled with inefficient domestica, the electric motor was suggested. The applications of this little power device about the house are without number. All operations, from dish washing to silver polishing, from dough mixing to ice cream freezing, may be done by the electrical servant, and at a cost which is no doubt less than that of the human servant. Then there was the electric laundry, the electric water purifying apparatus, washed air ventilators and countless suggestions for beautifying the home with ornamental lamps, electroliers, fountains, etc.

The decoration of the hall was most pleasing. The entire Madison Square Garden was draped in Nile green and white cheese cloth, with gold decorations. The hall was flooded with light, there being over a hundred thousand electric lamps. The lamps were arranged in triple-banked octagonal electroliers, of which there are three down the center of the hall, and twenty-eight suspended about the oval arena. As one entered the show he was greeted by a representation of Father Knickerbocker juggling electrically lighted balls of different colors.

While the major part of the show appeared to be particularly adapted for those who are interested in the household use of electricity, there were many other valuable and instructive exhibits. A complete line of advertising specialties was shown, and a practical demonstration of the best methods of lighting stores and store windows was given by devoting nearly the entire south side of the arena platform to model store fronts artistically illuminated. Another point of interest in the exhibition was the display of testing apparatus, where not only electrical appliances were tested, but other devices and materials as well.

For the first time in the history of the Electrical Show, Thomas Edison took a booth, the object being to demonstrate his storage battery, of which we have heard so much for many years, and which has only recently been reduced to commercial practice. Here the spectator was shown how flake nickel is produced by nickel-plating copper, cutting up the plated metal into tiny snips and then dissolving the copper by means of acid. The various processes of forming the perforated tubes, which are filled with flake nickel and nickel oxide, were explained.

Owing to the fact that the Electrical Vehicles Association of America was holding its annual convention here at this time, the display of electrical trucks and pleasure vehicles was unusually complete. This, by the way, demonstrates another growing electrical industry, which central power stations find to their interest to promote. The Korn photo-telegraphic machine is one of the novelties of the exhibition. There was a noticeable absence of wireless apparatus. While the show contained nothing startlingly novel, it was a decided success, as a brilliant spectacle and from an educational point of view as well.

## RECENTLY PATENTED INVENTIONS.

### Pertaining to Apparel.

BED-ROBE.—EMMA C. HAMPTON, New York, N. Y. This invention is an improvement in bed robes for invalids, such robes, for example, as night robes, chemises and night shirts, and has in view a garment which can be kept clean and sanitary under all conditions, and which can be readily put on and taken off a person in a recumbent position. The garment in place needs no hooking, buttoning, or strapping.

### Electrical Devices.

TROLLEY-CAR-POLE ATTACHMENT.—G. R. DUNN, San Pedro, Cal. The present improvement is a safety attachment for the frame of the apparatus, by which the movement of the frame relative to the forked bar carrying the trolley-wheel is limited, so that the wheel will maintain its proper position relative to the wire even if the spring chain connected with the harp should break or detach.

ELECTRIC-LIGHT SOCKET.—W. H. WALTERS, Salt Lake City, Utah. Mr. Walters's invention is an improvement in electric light sockets, and the object is to provide a three-point socket having a novel turning-off mechanism, which may be easily operated. It may be used as a two or three point socket; when as the latter and connected with a three-point switch, the desired results in making and breaking circuit are attained at either the switch or socket.

### Of Interest to Farmers.

FRUIT-PICKER.—A. J. PETERTYL, Traverse City, Mich. This invention is an improvement in fruit pickers, more especially for cherries, and belongs to that class of such devices as comprise a receptacle having clippers or shears arranged thereover for cutting off the fruit, the latter dropping into the receptacle as the stems are severed.

### Of General Interest.

GLUE-FAUCET.—C. M. ZIMMERMAN, Cincinnati, Ohio. Heretofore molasses faucets have been generally used on glue kettles. They are unsatisfactory as the valve frequently sticks and requires a very strong pull to unseat it. This often results in breaking the faucet, and sometimes causes the faucet to be torn from the kettle or the kettle from the stand. The present faucet overcomes such objections, and the force incident to opening of the valve, reacts against the vessel, ordinarily through the valve housing or mounting.

LANTERN-HOLDER.—A. C. HEWITT, Cohoes, N. Y. This invention refers to a device the purpose of which is to hold a lantern. It is particularly adapted for holding hand lanterns of the type used by trainmen. The object is to produce a device having a special construction facilitating its attachment to a post or arm. The invention also comprises a bracket which facilitates the attachment of a lantern before a gage, such as a steam gage.

POSITIONING AND FOCUSING INDICATOR FOR ENLARGING AND REDUCING CAMERAS.—A. FRUWIRTH, New York, N. Y. The object here is to provide scales by which the lens and ground glass may be accurately set for any size enlargement or reduction within certain limits, while avoiding usual focusing and possible errors from this source, thus adapting the camera to be as effectively used for this work by an amateur as by a professional.

FISH-SCREEN AND SLUICE-BOX.—DR. A. J. COLLAR, Yreka, Cal. In this invention the object of the improvement is the provision of a rotatable screen for use in irrigating ditches or flumes for the purpose of preventing fish running along the same so as to pass out on to the land where the water is utilized, and thus dying there.

SELF-CLOSING JOINT FOR VESSELS.—L. GRANGER, 25 Boulevard Barbes, Paris, France. The use of this device is facilitated by the fact that in order to effect the closing it suffices to turn a washer of relatively insignificant weight, instead of rotating the self-closing cover itself. The effort being equally spread over all the teeth or full parts of the cover and washer, the reliability of the closure is increased. The device renders possible the locking by self-closure of vessels of every shape.

WIRE FENCE.—D. A. CLAWSON, Waynesville, Ill. The object here is to provide a fence formed of line wires stretched from post to post, and connected by wire stays fastened to the line wires by twisting the ends of each stay wire around the top and bottom line wires and doubling up portions of the stay wire and bending the same around the line wires intermediate the top and bottom line wires, the fence being preferably built with the aid of a wire fence machine.

DEVICE FOR STRETCHING FURS OR SKINS.—E. H. BULLIS, Winnebago, Minn. The object in this case is to provide a simple device that may be readily applied upon the skin of an animal while it is in fresh condition, and after its engagement therewith be adapted to receive such adjustment as will stretch the skin in different directions, and retain the skin in distended condition, until the device is removed therefrom.

METHOD OF BUILDING DOCKS.—T. N. BERGE, Hoboken, N. J. The invention refers to methods of building docks and similar structures, the more particular purpose being to provide for performing the work progressively, beginning at the top of the ground and completing section by section of the dock wall as the excavation is carried downward—thus excluding as far as practicable, entrance of surface water while the work is being conducted.

TUBULAR RECEPTACLE.—W. W. RAGLEY, New York, N. Y. This invention is an improvement in tubular receptacles, particularly those constructed of sheet metal, and has in view a receptacle embodying a tubular body portion, a tubular neck of reduced diameter and a conical or tapering portion connecting the body portion of the neck, the receptacle being adapted to be economically produced in one piece from a blank.

NON-REFILLABLE BOTTLE.—J. T. BLUFF, Butte, Mont. This device is cast entirely of glass and is so cast that after being once corked it is almost impossible to extract the cork so as to refill the bottle. On account of the absence of moving parts, valves, etc., it is never subject to the danger of movable parts getting out of order and defeating the purpose of the device.

JAIL-BAR.—W. F. KLETT, Mobile, Ala. In this invention an alarm will be sounded in the event of any one attempting to saw through the bars. If a cut be made through the casing tube or shell by a saw, file or other cutting instrument, such instrument when coming in contact with an inner rotatable rod will cause the latter to turn, thus preventing the instrument from cutting the rod and also causing an explosion and alarm.

### Hardware and Tools.

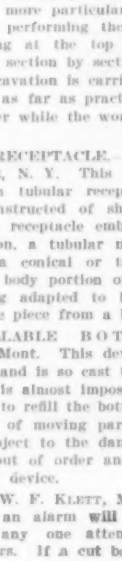
TICKET OR TAG HOOK.—F. S. WEBSTER, Lexington, Neb. In the present patent the invention will be found useful wherever it is desired to attach hooks to tickets for convenient connection with articles and the fastener is especially designed for jewelers' use in attaching tags on repair and display work avoiding the use of string and similar fastenings.

SPIKE-PULLER.—J. B. MILLER, Mount Pleasant Mills, Pa. The objects here are: To provide in an implement a combined push and draw bar; to provide disengaging means automatic in operation for releasing the draw bar from the article operated upon; and to provide an effective tool, the parts whereof are formed on lines adapted to the requirements of the conditions of operation.

NAIL OR SCREW CASE.—F. A. BILLSTONE, Findlay, Ohio. The aim of the invention is to provide a case for holding different sizes or different kinds of nails, screws, or similar fastening devices, and the construction is such as to facilitate the convenient removal of the nails or screws when they are to be used.

### Household Utilities.

WINDOW SCREEN.—JOSEPH B. OGBORN, 35 West Poplar Avenue, San Mateo, Cal. The accompanying engraving illustrates an improvement for the house, comprising a pocket for receiving a window screen. The screen



POCKET FOR WINDOW SCREENS.

is made comparatively thin to enter the pocket loosely, and is provided with guides for holding it in proper alignment. This permits of moving the screen clear of a window whenever desired. When the sash is lowered, the screen moves with it, screening the opening against flies and other insects.

BED FOR INVALIDS.—A. F. CRANDALL, Beresford, S. D. The invention in this instance is to provide a plug adapted to close a commode opening in the mattress of the bed, the member carrying the plug being adapted to be connected to a section of the mattress support, so that the plug will be moved relatively to the commode opening when the said mattress section is raised or lowered.

CONCRETE POST FOR CLOTHES-LINES.—T. H. LAURENT, Nutley, N. J. Among the principal objects which are in view in this case are: To provide a post for supporting clothes lines which will not rot when placed in the ground or become demolished by exposure to the climate; and to provide a post for the purpose set forth which is durable and economical in manufacture and installation.

BED.—A. F. CRANDALL, Beresford, S. D. In this invention the improvement is in beds for invalids and hospital use, the same being designed with a view of supplying all the necessities and comforts in the care of a patient without the inconvenience of removing the patient from the bed for any purpose whatever.

### Heating and Lighting.

COMBINED HEATER AND RADIATOR.—E. V. BENTLEY, Everett, Wash. The purpose in this instance is to provide novel details of construction for a heat radiating stove that may be readily converted into a cooking stove, the device being well adapted for consuming liquid fuel or coal by slight changes in construction.

APPARATUS FOR CLEANING GAS.—J. S. ANTHONY, Durango, Mexico. The aim in this case is to provide means which will cause water and other fluid to flow against the flow of gas, the water or other fluid being given a transverse, or rotary, movement relatively to the gas in the direction of its flow as the gas passes therethrough.

### Machines and Mechanical Devices.

STOP-MOTION.—J. MCGINNIS, Scranton, Pa. In the present patent the object of the invention is the provision of a new and improved stop motion, more especially designed for use in knitting and other machines, and arranged to quickly stop the machine in case that any one of the yarns breaks between the spool and the knitting devices.

AIR BRAKE MECHANISM.—H. T. RYDER and J. P. JOHNSON, Greensboro, N. C. This improvement provides in connection with a balanced release valve in connection with the train pipe a trapped air pipe leading from said release valve to the opposite trucks and automatically operated devices in connection with the opposite trucks for releasing pressure in the trapped air pipe, thereby releasing pressure in the release valve and setting the brakes in the usual manner.

DRILL-CHUCK.—A. KNAPP, Houma, La. This invention is an improvement in drill chucks, and the purpose is to provide a chuck of the character specified which will securely hold a drill point, while at the same time permitting its easy and quick removal and replacement, and which will be simple and inexpensive to construct, and not liable easily to get out of order.

CRANK-PIN CONNECTION FOR WELL-DRILLING MACHINERY.—J. F. KEITH, Naples, N. Y. This driving mechanism for drills is such as used for drilling oil wells, or for similar purposes. The invention produces an improved form of connection between the pitman or connecting rod and the crank, and while the invention is especially applicable when used with the mechanism suggested, it is capable of use in machinery of other classes.

PRESSURE-REDUCING VALVE.—T. P. FORD, New York, N. Y. The inventor provides a pressure reducing valve, arranged to permit the operator to conveniently and quickly set the valve with a view to reduce the pressure of water, gas or other fluid flowing through the valve to any desired degree by using a valve arranged to open by initial pressure and to close by reduced pressure, the valve being controlled by pressure action on different piston areas having connection with said valve, and arranged to permit manual control for rendering any one of the pistons active at a time.

CHARGE-FORMING DEVICE FOR INTERNAL-COMBUSTION ENGINES.—H CASSEDY, SR., and R. S. PURSER, Brookhaven, Miss. This invention relates to improvements in mechanism for forming, controlling, and delivering charges of explosive mixture to internal combustion engines, and the aim is to provide for the delivery of a uniform mixture of air supercharged with the vaporized fuel and to dilute this mixture to the desired extent before delivering it to the engine.

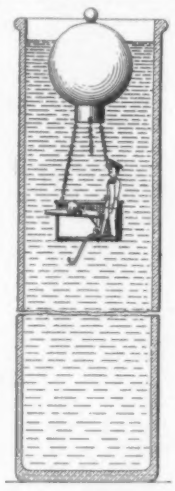
### Railways and Their Accessories.

CAR-TRUCK.—G. ROUY, New York, N. Y. This invention constitutes an improvement upon the truck disclosed in patents formerly granted to Mr. Rouy, and refers more particularly to a truck which comprises pairs of spaced, longitudinal frame members, the wheels being mounted for independent rotation between the members of the pairs and end members connecting the inner frame members only of said pairs, whereby the wheels can be easily removed at the ends of the frame members.

RAILWAY TRIP DEVICE.—A. M. JONES, Hagerstown, Md. An object of this improvement is to provide a device by which a tappet or other projecting portion connected with a valve stem on an engine may be positively moved to effect the stopping of the train. To this end a trip is provided adapted to be raised or lowered, of sufficient length to insure the positive action of the emergency valve.

### Pertaining to Recreation.

TOY.—JOHN VANDERBILT, 28 Eleventh Street, New York. The problem of providing entertainment for children, not only on clear days (when they can play out in the open), but also on rainy days, is here successfully met. Mr. Vanderbilt has succeeded in this in-



BUOYANCY TOY.

stance in providing a floating body, or balloon, and a medium in which it can float, together with a basket carried by the balloon and provided with means for receiving a small weight when the balloon is in its uppermost position, and for causing the release of the weight when the balloon is in its lowermost position.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## Notes and Queries.

Kindly write queries on separate sheets when writing about other matters, such as patents, subscriptions, books, etc. This will facilitate answering your questions. Be sure and give full name and address on every sheet.

Full hints to correspondents were printed at the head of this column in the issue of June 18th, 1910, or will be sent by mail on request.

(12302) R. D. B. says: I wish to use liquite (not worth paying transportation charges) to create power to be transmitted by wire for a distance of 60 to 100 miles, is this practicable? Please advise me of any publications giving information on the subject. A. It is entirely practical to transmit power or run lights by electric current at a distance up to 250 miles from the generator. Bell's "Electric Power Transmission," price $4, and Koester's "Steam Electric Power Plants," price $5, will inform you upon the subject. Upon receipt of the prices quoted above we will forward these books postpaid to your address.

(12303) W. F. F. asks: Will you kindly inform me approximately how much horse-power would be developed from a 4-inch stream falling 100 feet? Also how many horse-power can likewise be developed by a 6-inch stream falling 200 feet? If you can give me some formula by which I myself could estimate the horse-power, I would esteem it a favor. A. The horse-power developed by falling water, or by any falling substance, is measured by the product of the weight of the substance falling and the distance of the fall. Each horse-power involves a fall of sufficient weight, and from a sufficient height, to produce 33,000 foot pounds of work per minute. To determine the horse-power of your waterfall, it is therefore necessary to find the number of pounds of water passing over the fall per minute. Multiply this number of pounds by the vertical height in feet, and divide by 33,000; the quotient will be the horse-power. If you intend, however, to ask the horse-power produced by a stream of water issuing from a 4-inch diameter hole under a head of 100 feet, that is, coming from a reservoir whose level is 100 feet vertically above the center of the 4-inch opening, there is a means of determining the quantity of water approximately by calculation. The velocity of the stream of water can be obtained from the formula $v^2 = 2gh$, where $v$ is the velocity in feet per second, $g$ acceleration due to gravity, or 32.16, and $h$ the head in feet. For the 4-inch stream and 100 feet head, $2gh = 6{,}432$; for the 6-inch stream and 200 feet, $2gh = 12{,}864$. The velocity of the 4-inch stream is therefore 80 feet per second, and of

the 6-inch stream 113 feet per second, nearly. The weight of water through the 4-inch opening is 436 pounds per second, and through the 6-inch opening 1,390, and the horse-power of the 4-inch stream would therefore be 8/10, and of the 6-inch stream 2⅘. Both of these figures must be reduced, first, because the flow through the opening would be probably not more than 2/3 to 4/5 of the theoretical; and, second, because the efficiency of your waterwheel will not be much over 60 per cent, if it is that. Apparently you would get about 1/3 horse-power from the 4-inch stream, and say 1½ horse-power from the 6-inch.

(12304) H. B. M. asks: Please advise briefly if a centrifugal pump will work well where there is a lift of say 10 to 15 feet. Should not there be a fall to the pump in order to get satisfaction out of such a pump? A. There is no difficulty in operating a centrifugal pump with a suction lift of 10 to 15 feet, provided there is some way to prime the pump when starting, as from a city water connection or a bypass from the discharge pipe, if that remains full of water. A foot valve must be used on the bottom of the suction pipe. The whole trick in starting a centrifugal pump is to have the suction pipe and pump itself entirely full of water, without air, before the pump is started. It might be possible under some conditions, such as pumping from a rapidly flowing stream, or repumping returns from some compressed-air system, to have water so foamy that the air will collect in the pump faster than the pump could throw it out. Under such conditions a suction lift would be very objectionable, and the pump could be submerged so as to remain full of water under all conditions.

(12305) A. B. says: I have a spyglass and want to determine the magnifying power of same. Could you kindly explain to me in a few words, or have you a number of the SCIENTIFIC AMERICAN in which a method is given? A. The magnifying power of a telescope is easily found, approximately, by looking at a wall of brick or other objects of a uniform size, with one eye through the glass, and with the other at the same time directly through the air without the glass. By close attention you will soon see with both eyes, the magnified object through the glass, and can tell how many of the objects seen in the other eye the magnified object covers. This gives the magnifying power.

(12306) H. M. says: Will you kindly inform me what causes a baseball to curve? I understand that a rapid twirling of the ball is necessary to produce a curve, but I cannot understand how it does it; nor can I account for the "break" which some pitchers are able to throw. Does the seam on a baseball have anything to do with the curve? A. The curving of a baseball is produced by its rapid rotation and the friction of the air upon it, causing the air to become denser on the side toward which the front of the ball rotates, and rarer on the opposite side, as some air is carried around by the turning of the ball. There is thus a greater pressure of the air on the side where the air is denser, and this pushes the ball in the opposite direction, or toward the side where the air is rarer. The seams on the ball may help push the air around in the direction of the rotation of the ball. See Hastings and Beach, "General Physics," page 135.

(12307) A. K. asks: Would you kindly advise me if there is any method by which a person could find out which he is adapted for—a profession or a handicraft? A. No one can tell in advance for what profession or handicraft a man is best adapted. From our general knowledge of conditions in the practical world, we believe that the broadest field of all is offered to the handicraftsman who has sufficient brains and application to gain professional knowledge to back his manual skill. For instance, it is impossible to obtain a sufficient number of skilled foundry foremen, simply because so many men with the necessary brains to learn the theory and science of iron founding will not soil their hands and undergo the hard labor necessary to acquire the practical knowledge required by the foundry foreman. We suggest you take up whatever trade most interests you, and while you are mastering the practical side, give all the time you can spare from sleep to reading and studying the theory.

(12308) J. H. F. asks: Will you kindly inform me through the SCIENTIFIC AMERICAN if steam is visible or invisible, that is, can it be seen? A. Steam is invisible; look at the water glass on the nearest steam boiler, and see whether you can see any white mist above the water-line. When steam is admitted into the air, it condenses into fine mist drops, which appear white like snow flakes, though snow flakes and mist drops are clear as water or glass, if examined closely. Watch the steam from the cylinder drains of a locomotive, a dense white cloud disappearing at a little distance, as soon as the mist drops formed by the cooling steam are able to take up heat from the air and evaporate back into vapor again. Much information on all scientific subjects can be obtained in back numbers of the SCIENTIFIC AMERICAN SUPPLEMENT, which are furnished at the nominal price of ten cents each. Our extensive subject catalogue of these articles or our catalogue of scientific books will be sent free upon request.

## NEW BOOKS, ETC.

A PRACTICAL COURSE IN MECHANICAL DRAWING. By William F. Willard. Chicago: Popular Mechanics Company, 1910. 18mo.; 134 pp. Price, 50 cents.

This is a book for individual study, shop classes, trade or high schools, and those who would like to know something of the drafting process. There are 131 illustrations, which are quite well executed. It is remarkable that so good a book can be produced at such a low figure.

DESIGN OF MARINE MULTITUBULAR BOILERS. By James D. McKnight and Alfred W. Brown, A.M.I.Mech.E. London: Technical Publishing Company, Ltd., 1910. 8vo.; 48 pp.; plates. Price, $1.60.

This treatise has been issued for the use of those engineers and draftsmen whose experience has been wholly or mostly on engine work, but who are anxious to learn something of the boiler side of their business. The book is intended solely for the draftsman to enable him to design special sizes and pressures to the requirements of the various surveys. Of course, the practice is British practice, but the book will undoubtedly be of value to American boiler-makers as well.

ECONOMIC GEOLOGY WITH SPECIAL REFERENCE TO THE UNITED STATES. By Heinrich Ries, A.M., Ph.D. New York: The Macmillan Company, 1910. 8vo.; 589 pp. Price, $3.50 net.

After a very careful examination of this book we feel that it is no more than fair to say that the author has made a great contribution to the literature of economic geology. Above all, the information is in most usable form and is a masterpiece of concentration. The maps themselves are well executed, the illustrations are numerous, well selected, and beautifully printed. The author is too well known a geographer to question or criticise his text, and the bibliography which he gives is of the greatest possible usefulness. This is a new and revised edition of a work that has already stood the test for a number of years. The mechanical execution of the book is one of the best which we have seen.

MINUTES OF THE COMMISSIONERS FOR DETECTING AND DEFEATING CONSPIRACIES IN THE STATE OF NEW YORK. Albany County Sessions. Volume I., 1778-1779; Volume II., 1780-1781. Volume III., Analytical Index. Edited by V. H. Paltsits, State Historian. Albany: Published by the State, 1910.

The State Historian is to be congratulated in gathering such a valuable collection of material, which he has thrown into proper sequence as only an expert archivist can do. An attempt is here made to analyze the laws passed for the repression of disaffection in the State, particularly as related to the Commissioners for Detecting and Defeating Conspiracies, whose Albany minutes form these volumes, and to digest some of the main features of the proceedings of these Commissioners as operated under the laws by which they were to be governed. The idea of combining forces for detecting and defeating conspiracies was not a new one; for in conserving the State against the machinations of disaffected, disloyal, and even decidedly inimical persons, progress media have been determined and executed by local and county committees by the Provincial Councils and Conventions, and otherwise. The books are beautifully printed, and there are a number of excellent reproductions of documents. The books will prove of great value to those interested in the history of the State of New York or in the times following the war of the Revolution.

THE SPECTROSCOPE AND ITS WORK. By H. F. Newall, M.A. London: Society for the Promotion of Christian Knowledge, 1910. 16mo.; 163 pp.; 8 plates. Price, $1.

The literature on the spectroscope is very voluminous, but doubtless the little work before us will prove of some value to the beginner.

RULES AND FORMULAE WITH SUGGESTIONS PERTAINING TO GOOD PRACTICE, ENDORSED AND ADOPTED BY THE INTERNATIONAL MASTER BOILER MAKERS' ASSOCIATION. New York: Published by the Association, 1910. Office of the Secretary, 95 Liberty Street, New York. 18mo.; 65 pp. Price, $1.

This edition is intended to supply information and tables of value and service to those engaged in the designing and inspecting of steam boilers, generators, also other receptacles for holding pressure. The work will be of great value to boiler makers.

QUESTIONED DOCUMENT. A Study of Questioned Documents With an Outline of Methods by Which the Facts May be Discovered and Shown. By Albert S. Osborn. With an introduction by Prof. John H. Wigmore. Rochester: The Lawyers' Co-operative Publishing Company, 1910. 8vo.; 501 pp.

A century ago the science of handwriting did not exist, but to-day all revelant branches of modern science have been brought to bear on Questioned Documents. A firm place has now been made for the expert witness who is scientific and not merely empiric. Each age has its crimes with the corresponding protective measures—all alike the product of the age's conditions. Forgery is not by any means a new art, having flourished in the middle ages. Within the last one hundred years we have perhaps seen forgery run riot; and if it were not for the correctives which the law furnishes, and to which the handwriting expert has contributed, our society would be at the mercy of clever swindlers. Now however the forger sees that he must have to take considerable chances before he starts his nefarious operations, and he commits a crime with his eyes open. The book before us is a fascinating one; detective cases are often more interesting in real life than in the pages of Conan Doyle and Hornung. The book is a most scholarly one, and is beautifully illustrated by examples showing that the author is a master of his subject.

THE LURE OF THE ANTIQUE. By Walter A. Dyer. New York: The Century Company, 1910. 12mo.; 499 pp. Price, $2.40 net, postage 18 cents extra.

This is a valuable book of ready reference for collectors of old furniture, china, mirrors, candlesticks, silverware, pewter, glassware, copper utensils, clocks, and other household furnishings of our American forefathers, and a handy guide for the determination of age, style, maker, genuineness, and value, and is beautifully illustrated by one hundred and fifty-nine half-tones describing the pieces represented and also giving the approximate value. The chapter headings are as follows: The Quest for the Old and Beautiful—Old Chairs in Modern Houses—Old Desks and Secretaries—Tables and Sideboards—Four-poster Bedsteads and Others—Some Old Clocks—The Looking-glasses of a Hundred Years Ago—Old Lamps and Candlesticks—Old Blue Staffordshire—The Beautiful Pottery of Wedgewood—Luster-ware—The Lure of Lowestoft—Salt Glaze—English and American Glassware—Bohemian Glassware—The Collecting of Old Silverware—The Pewter on the Dresser—Sheffield Plate—Old Brass and Copper—Where Ancient Back-logs Glowed—The Truth About Antique Furniture. It is a beautifully made volume, and the half-tone insets are printed on coated paper. The chapter headings and tailpieces are from charming drawings by Harry Fenn. This is a companion volume to "The Quest of the Colonial."

LANDSCAPE GARDENING STUDIES. By Samuel Parsons. New York: John Lane Company, 1910. 12mo.; 106 pp. Price, $2 net, postage 20 cents extra.

The work illustrated and described in this unpretending book represents the author's own undertakings. His concrete examples are selected to show by pictures and pen how some problems of landscape gardening were solved by him. They represent in a simple way some of the basic principles of the art. It will be noticed that no reference has been made to the actual design of architecture. One difficulty with the landscape architect has often been that he will undertake to design buildings, something which is really outside of his domain. His province is to deal with Nature to render her beautiful, but always herself—always Nature. He needs a life-time of study to catch the stir of her beauty and transcribe and utilize it for man's use and enjoyment. The author has produced a thoroughly sound book that should be in the hands of every architect as well as landscape architect. The book is beautifully printed and illustrated, and is neatly bound.

THE STORY OF SUGAR. By George Thomas Surface. New York: D. Appleton & Co., 1910. 16mo.; 238 pp. Price, $1 net.

Excepting the technical and trade literature, very little has been written on the world's sugar industry, and yet no commodity of commerce has had a more varied, interesting, and significant history. This volume is intended to convey accurate and valuable information on the industry in the different periods and stages of its development. Although it is primarily designed for the general reader, the study is replete with facts and economic deductions which will make it a valuable source of reference in any course on industries or commerce. Naturally, the beet-sugar industry receives special consideration from the standpoint of future prospects, since this must be regarded as an infant industry in the light of its rapid growth during the past two decades.

GAME AND TRAIL METHODS. By E. Krebs. Columbus, Ohio: The A. R. Harding Publishing Company, 1910. 16mo.; 273 pp. Price, 60 cents.

A life in the open air calls for special knowledge, which is sometimes gained only at more or less disagreeable experience. The object of the author is to enlighten "outers," and give them the information which will start them on the right trail. There are many works on outdoor life, but only a few of these books were written by practical woodsmen and for people who want to belong to that class. This book not only gives information which is needed by the summer camper, but gives practical attention to the needs of those whose calling leads them into the wilds; these and many others will find much valuable information in this book. The directions are eminently common-sense, and the whole book is extremely useful from a practical point of view.

POWER GAS AND THE GAS PRODUCER. By J. C. Miller, M.E. Chicago: Popular Mechanics Company, 1910. 12mo.; 192 pp. Price, $1.

Scarcely twenty years have gone by since the gas producer was first proposed for power purposes, and in this short time its growth in use and in potentiality has proceeded by leaps and bounds. The new method of adapting the latent power in coal to man's best use is still a mystery even to the well informed, because nearly all the literature on the subject has been written under the assumption that the reader knows as much about the subject as the writer. A comprehensive treatise, clear of abstruse technicalities, in every way authentic.

SWINGLE'S PRACTICAL HAND BOOK FOR MILLWRIGHTS. Chicago: Frederick J. Drake Company, 1910. 12mo.; 229 pp. Price, $2.

This book describes the planning and arrangement of mill buildings, strength of materials, couplings, shafting, horse-power, pulley location, belts and belting, wire rope transmission, and all subjects directly connected with the installation of mill machinery, and the author is a well-known writer on mechanical engineering. Many of the illustrations are reproduced from other sources, and they could be much improved upon.

CRETE, THE FOREBUNNER OF GREECE. By Charles Henry Hawes and Harriet Boyd Hawes. With an Introduction by Arthur J. Evans. London and New York: Harper & Brothers, 1910. 18mo.; 157 pp. Price, 75 cents.

The recent discoveries in Crete have added a new horizon to European civilization. A new standpoint has at the same time been obtained for surveying not only the ancient classical world of Greece and Rome, but the modern world in which we live. This revelation of the past has thus more than archæological interest. It concerns all history, and must affect the mental attitude of our own future generations in many departments of knowledge. Mrs. Hawes has carried out the excavation of the Minoan situation at Gournia, the results of which have been presented to the world in a scientific form in an admirably illustrated volume. Mr. Hawes, on the other hand, by his researches into both the ancient and modern life of Crete, has made far and away the most important contribution of their ethnological divisions and physical characteristics that has yet appeared. Under such guidance the reader may safely trust himself to obtain all this capital Minoan world has to offer. The book is daintily made, and is accompanied by a number of plans.

THE PRESSURE OF LIGHT. By J. H. Pointing, Sc.D., F.R.S. London: Society for Promoting Christian Knowledge, 1910. 18mo.; 103 pp. Price, 80 cents.

In the course of the last few years the author has lectured on the Pressure of Light in many places. Some of the lectures have already been published in full or in abstract. In this book the substance of these lectures is set forth more completely and in greater detail than is possible in any one lecture. The series of notes gives the mathematical calculations involved in the theory of the subject, which is a most fascinating one.

COAL MINES. Cleveland, Ohio: B. H. Rose, 1910. 8vo.; 278 pp. Price, $5.

This work covers the bituminous and semi-bituminous mines of the States east of the Mississippi River. The information contained is authentic, coming directly from the operators themselves. The index will be found very useful to anyone dealing with the mines, as it shows the location of the general office, purchasing agent's name, and also his address when located at some other place. It is the intention to revise this book annually.

RAILROAD ADMINISTRATION. By Ray Morris, M.A. New York: D. Appleton & Co., 1910. 12mo.; 209 pp. Price, $2 net.

The idea in this book is to tie together the study of the various branches of railroad operation as the general manager of a road has to tie them together. The general manager often finds that his mechanical engineers are more interested in their own special kinds of records than they are in the broad welfare of the property. Yet the general manager of a small road or the vice-presidents or president of a big one have to co-ordinate the work of all these specialists to the common good. In a word, the work is intended to help broaden the young specialist by giving him an idea of the relation of his specialty to the entire program, and it is also intended to give the non-technical man a general idea of how the general problems in administration are gotten at.

TOTEMISM AND EXOGAMY. A Treatise on Certain Early Forms of Superstition and Society. By J. G. Frazer, D.C.L., LL.D., Litt.D., F.B.A. London: Macmillan & Co. New York: The Macmillan Company, 1910. Four volumes. 8vo.; 580 pp. each. Price, $16.

The amount of erudition which is displayed by the author of these four ponderous tomes is remarkable, and certainly suggests scholarship of a very high order. The author has

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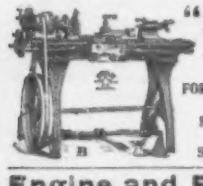

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attempted to paint savagery in its true colors. He has extenuated nothing, softened nothing, and exaggerated nothing. As a plain record of a curious form of society which must soon be numbered with the past, the book may continue to possess an interest even when, with the progress of knowledge, its errors shall have been corrected and its theories perhaps superseded by others which make a nearer approach to truth. The author never hesitates to form theories which seem to fit the facts, or to throw them away again when they cease to do so. He states that his aim in this and other writings has not been to blow high-bubble hypotheses which glitter for a moment and are gone, but it is by a wide collection and exact statement of facts which lay a broad and solid foundation for a broad study of primitive man.

WORKSHOP WRINKLES AND RECIPES. Edited by Percival Marshall. London: Percival Marshall Company, 1910. 16mo.; 96 pp. Price, 50 cents.

This is a gathering of shop wrinkles, somewhat after the order of our Handyman's column, and does not call for special attention.

## Legal Notices


**PATENTS**

**INVENTORS** are invited to communicate with **Munn & Co., 361 Broadway, New York,** or **625 F Street, Washington, D. C.,** in regard to securing valid patent protection for their **inventions. Trade-Marks** and **Copyrights** registered. **Design Patents** and **Foreign Patents** secured.

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## INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending October 11, 1910,

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

| | |
|---|---|
| Account apparatus, credit, J. T. Brooke | 972,154 |
| Acetylene generator, F. E. Stover | 972,285 |
| Adjustable and quick acting clamp, I. A. Rommer | 972,253 |
| Advertising device, moving, S. J. Scott | 972,258 |
| Air brake, pressure regulator, D. H. Downey | 972,347 |
| Air compressor, A. O. Carpenter | 972,161 |
| Air compressor, W. L. Crane | 972,163 |
| Air filter, C. Guntrum | 972,183, 972,184 |
| Alloy, antifriction, J. R. Stratton | 972,786 |
| Amusement apparatus, P. Wintermute | 972,310 |
| Amusement apparatus, G. A. Budge | 972,750 |
| Anchor, ground, J. Wilcox | 972,306 |
| Antiskidding device for automobiles, A. Hormel | 972,766 |
| Applicator, A. D. Foster | 972,686 |
| Auger, J. Frahlich | 972,611 |
| Auger apparatus, M. E. Miller | 972,392 |
| Automobile steering wheels, locking device for, Elliott & Reilly | 972,605 |
| Automobile wheels, armor for, B. L. Rekeß | 972,322 |
| Automobiles, lever lock for, H. Hood | 972,193 |
| Bag fastener, Hiering & Fuller | 972,765 |
| Ball, well bucket, F. D. Walpole | 972,693 |
| Bait, artificial, Breder & Loyd | 972,748 |
| Barrel, W. L. Ward | 972,664 |
| Bath apparatus, shower, G. Winters | 972,589 |
| Battery circuit controller and tester, storage, H. N. Motsinger | 972,210 |
| Bearing, spindle step, D. N. Wild | 972,743 |
| Bed, folding, L. B. Jeffcott | 972,537 |
| Bed, table, and seat, folding, G. A. Swanson | 972,484 |
| Beds, leg mounting for uptilting, N. C. Merrill | 972,462 |
| Bedclothes holder, J. Campbell | 972,159 |
| Bedstead, sofa, M. Thomson | 972,293 |
| Bench dog, adjustable, J. Fletcher | 972,610 |
| Berry box, P. Henrich | 972,696 |
| Berth for infants, collapsible, W. J. Temple | 972,732 |
| Bicycles, pivoted lug for back forks of, C. M. Cosset | 972,510 |
| Bill fold, I. Barnett | 972,494 |
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### HENSON'S AEROPLANE OF 1843.

(*Continued from page 314.*)

propellers are to be worked, possesses some originality, both in the mode of generating steam adopted by the inventor, and in its subsequent condensation, but nothing that covers the inherent defect of the principle of the carriage. Want of space prevents our further examination in detail, but enough has been said to show its unfitness for the purpose for which it is intended."

The following extract from the specifications shows the ingenuity and thoroughness of Henson's work. Particularly would we draw attention to his use over fifty years ago of a condenser similar to the radiators in use to-day in aeroplane engines:

The covering of the wings and tail is of silk, or linen; that of the wings is divided into three lengths for each end, joining each other at the double frames shown; this division facilitates the rapid reefing and spreading of the covering, which is effected by the cords running parallel with the longitudinal pieces, *a*, *a*, *a*, etc., of the wings. The tail and rudder are in like manner governed by cords proceeding from the car.

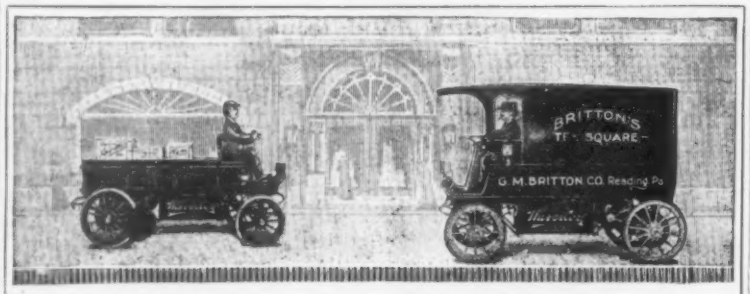
To the spectator the most striking part of the machine is the immense web which, in the most important respects, fulfills the office of wings. It consists of framework of great strength and extraordinary lightness, covered with silk or linen; its dimensions are not less than one hundred and fifty feet by thirty. It has neither joints nor the peculiar motion of wings, but is perfectly stiff from end to end. One of its long sides goes foremost, and is a little raised: to the middle of the other is jointed the tail, of fifty feet in length, beneath which is a rudder: a small vertical web, placed across the wings at their middle point, serves to check lateral oscillation. The several parts, like the main frame, are constructed with an especial view to the combination of the necessary strength with extreme lightness: the contrivance employed for this purpose is that of upright posts, or standards, to the tops and bottoms of which various points in the horizontal frame are connected by metallic braces. These parts are all shaped so as to pass through the air with the least possible resistance.

The car, and a very light and powerful steam engine, are suspended from the middle of the wings, and are close to its under surface: the steam engine actuates two sets of vanes, of twenty feet diameter and six vanes each, placed at the hinder edge of the wings, and as near to each other as the joint of the tail will permit.

The novelty of the steam engine, as we have elsewhere stated, lies chiefly, if not entirely, in its boiler and condenser. The former consists of nearly fifty hollow truncated cones, averaging about three feet in length, and of four inches and a half in their greatest width; their blunted points, of about one inch in diameter, are downwards, and the whole are arranged above and about the fire: they present about fifty square feet to the action of radiating, and about as much more to that of communicative heat. The steam is worked in two cylinders, in which it is cut off at one-fourth of the stroke. Computing the power of the boiler to generate steam, by data derived from the effects of those of railroad engines, we conclude that the engine will be found of nearly twenty horse-power.

The condenser is composed of a number of small tubes, into which the steam is admitted, and which are exposed to the current of air produced by the rapid flight of the machine. The plan has been found perfectly efficient, and it dispenses with the necessity of carrying water, either to supply the place of that which is discharged as steam when it has performed its work, as in high-pressure engines, or to condense it that it may be returned to the boiler. The effect of these

(*Concluded on page 331.*)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In SCIENTIFIC AMERICAN SUPPLEMENT, **1615**, A. Frederick Collins describes fully and clearly with the help of good drawings how an independent multiple interrupter may be constructed for a large induction coil.

This article should be read in connection with Mr. Collins' article in SCIENTIFIC AMERICAN SUPPLEMENT, **1603**, **"How to Construct a 100-Mile Wireless Telegraph Outfit."**

Each Supplement costs 10 cents; 20 cents for the two. Order from your newsdealer or from

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*(Concluded from page 330.)*

improvements in the boiler and condenser, combined with extreme simplicity and lightness in the other parts of the engine, is such that, though the engine is of the power of twenty horses, it is worked with twenty gallons of water; and its entire weight, with its boiler filled, is not more than 600 pounds.

### Traced Forgeries.

The most interesting testimony on this question of identity is perhaps that given by the late Prof. Benjamin Peirce, the celebrated mathematician of Harvard University, in the celebrated Sylvia Ann Howland case. It was found by careful examination and comparison under Prof. Peirce's direction that the probability of coincidence of each of the thirty downward strokes in this long signature was represented by the fraction one-fifth, and Prof. Peirce testifies as follows:

"I have carefully examined the signatures 1 and 10 of Sylvia Ann Howland. I have placed them over each other and have compared their magnified photographs. The coincidence is extraordinary and of such a kind as irresistibly to suggest design and especially the tracing of 10 over 1. . . . The relative frequency of coincidence expresses how often there is a coincidence in either of the characteristic lines, such as in line 1, for example. The product of the relative frequency into itself expresses how the coincidence of a characteristic line 1 is combined with that of line 2; the cube of the relative frequency of coincidence shows how often there will be the simultaneous combination of the coincidences of the three first lines, and so on.

"Finally, the relative frequency must be multiplied into itself as many times as there are characteristic lines to express how often there can be a complete coincidence in position of all the lines of the signature.

"In the case of Sylvia Ann Howland, therefore, this phenomenon could occur only once in the number of times expressed by the thirtieth power of five (nine hundred and thirty-one quintillions of times, 931,000,000,000,000,000,000). This number far transcends human experience. So vast an improbability is practically an impossibility. Such evanescent shadows of probability cannot belong to actual life. They are unimaginably less than those least things which the law cares not for."

The case has been incorrectly reported in nearly every reference to it in the decisions, the text books and magazine articles even down to the year 1909. In the first place the thirtieth power of five is not, as it has been reported, 2,666 followed by eighteen ciphers, but is 931 followed by eighteen figures. The difference in the numbers makes no practical difference in the argument, as the least is entirely beyond human comprehension. This strange error is in the original report of the case and has been repeated from that time. No doubt some change was made in the basis of the calculation without making the resulting change in the first reported result.

Another error that has been repeated in nearly every reference to the case is the statement that Prof. Peirce testified that "no two signatures will be identical," etc., but his testimony applied only to the signatures 1 and 10 in this particular case. The testimony in full and a most interesting and valuable *verbatim* report of the arguments of counsel are on file at the Public Library at New Bedford, Mass.

This famous case was finally decided on a point of law and the facts were never passed upon by court and jury.—West Publishing Company's Docket.

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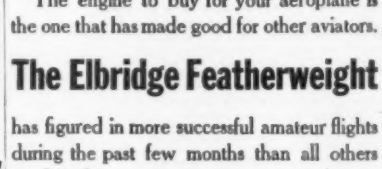

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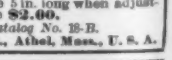

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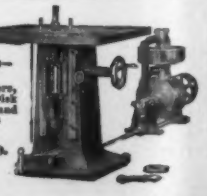

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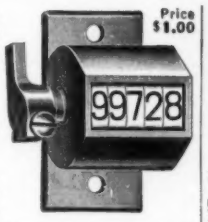


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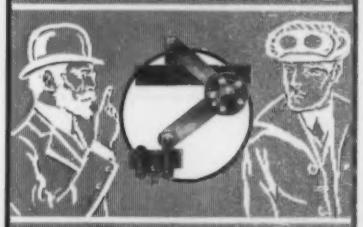

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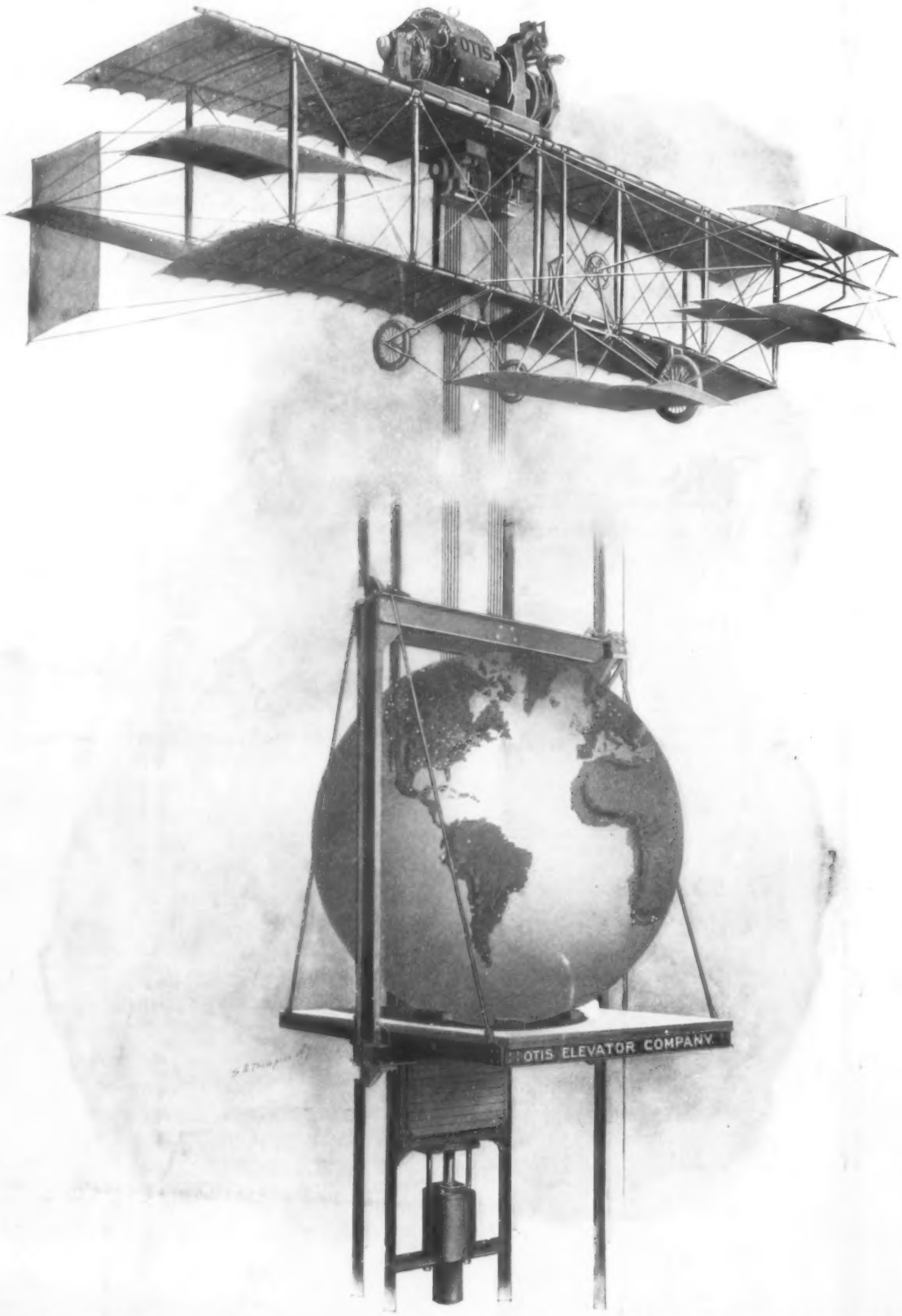


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